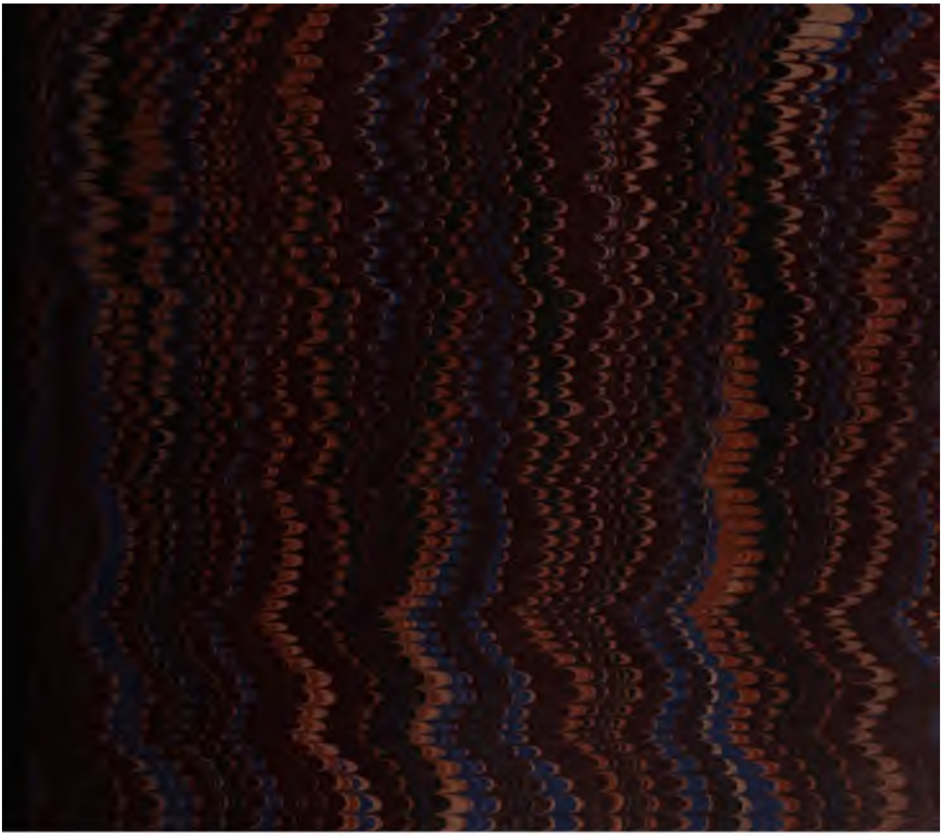

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1882.

PUBLICATION COMMITTEE:

JOSEPH LEIDY, M. D., GEO. H. HORN, M. D.,
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PHILADELPHIA:
ACADEMY OF NATURAL SCIENCES,
S.W. Corner Nineteenth and Race Streets,
1883.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
February 28, 1883.

I hereby certify that printed copies of the Proceedings for 1882 have been presented at the meetings of the Academy, as follows:—

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" 185 to 216	. . . .	August 29, 1882.
" 217 to 232	. . . .	October 17, 1882.
" 233 to 250	. . . .	October 24, 1882.
" 251 to 266	. . . .	December 12, 1882.
" 267 to 282	. . . .	January 2, 1883.
" 283 to 314	. . . .	January 16, 1883.
" 315 to 330	. . . .	February 6, 1883.
" 331 to 346	. . . .	January 30, 1883.
" 347 to 362	. . . .	February 13, 1883.
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EDWARD J. NOLAN,
Recording Secretary.

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PROCEEDINGS

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JANUARY 3, 1882.

The President, Dr. JOS. LEIDY, in the chair.

Twenty-six persons present.

Fruiting of Ginko biloba.—Mr. THOMAS MEEHAN referred to some specimens of this plant (*Salisburia adiantifolia* of Smith and other authors subsequent to Linnæus) which had been borne by a tree on the grounds of Mr. Chas. J. Wister, of Germantown. The tree was far removed from any other flowering tree, which afforded good grounds for the belief that this specimen was hermaphrodite. In botanical classification the genus was accepted as of diœcious character. Sexual characters were, however, among the most unreliable. There would be nothing improbable in a tree bearing wholly male or wholly female flowers as a general rule, changing so far as to have both on one tree. Cases of this kind were not uncommon in *Acer dasycarpum*, and other deciduous trees, and, he believed, probable in the red cedar, *Juniperus virginiana*, an ally of the *Ginko*. In this cedar there were often trees met with which were wholly male in most seasons, but on which occasional berries might be seen; while other trees, usually so abundantly fertile as to be almost covered with blue berries, would occasionally have many more male flowers than usual. In Rubiaceous plants, where dimorphic flowers were so common—the short-styled ones and the short-stamened ones being on distinct plants, and practically diœcious—there were cases of change at times. The white-berried *Mitchella repens* which were growing on his grounds, apart from the red-berried variety, had not produced a

berry until last year, when a few were produced; and the short-styled *Bouvardia*, so common in greenhouses, and with short styles, had produced a branch on one plant under his observation the past winter, which had the styles projecting beyond the corolla. In annual plants the variation in sexual characters was well known to vary, even with external conditions. *Ambrosia artemisiæfolia*, the common rag-weed, produces mostly male flowers in poor soil, or when growing thickly together in wheat fields after the grain is cut; but when growing in the richer soil of potato or Indian-corn fields, the increase of female flowers is very marked. Sometimes plants under these conditions are found wholly female. Indian-corn also varies through some innate law. Male flowers are not uncommon on the spikes which bear the grain, while grain among the males, or "tassels," showed the occasional presence of female flowers there. It is more than likely that complete diœcism, claimed for some Asiatic coniferæ, does not really exist.

Prof. Angelo Heilprin remarked that fruit had been found on this tree recently in the Central Park, New York; and that bees might carry the pollen long distances, and fertilize female flowers. It did not follow that the presence of fruit on isolated trees involved monœcism.

Mr. Redfield observed that pollen from the large male tree, three-quarters of a century old, at the old Hamilton homestead, now Woodlands Cemetery, and but six miles away in a direct line, might be wafted by winds to Mr. Wister's tree in Germantown.

The President, Dr. Joseph Leidy, remarked that pollen from coniferous trees was known to be carried by winds to enormous distances.

Remarks on some Rock Specimens.—Prof. Leidy remarked in relation to the rock specimens presented by him this evening, that most of them he had collected last summer on South Mountain, ten miles from Wernersville, Berks Co., Pa. The ridge consists of azoic rocks, mainly compact gneiss, often obscurely stratified and regular or not folded or contorted. With this is associated granite with little or no mica, and black syenite mostly composed of hornblende with feldspar and quartz in fine grains. The rocks in two localities of the vicinity are traversed by dykes of basaltic trap. Potsdam sandstone flanks the mountain on the eastern side, and this at the base is overlaid by the lower Silurian limestone of the Lebanon Valley. The specimens collected from exposures of the Potsdam sandstone consist of quartzite, remarkable for their sharply defined character, resembling in a manner cleavage fragments of orthoclase. The form is due to jointing, which is rhomboidal, usually in two directions crossing the planes of stratification, but also frequently parallel with the latter. Occasionally the jointing presents other

planes; thus one of the specimens, the size of an ordinary brick exhibits planes due to jointing in five different directions.

Incidentally to the foregoing, Prof. Leidy said that it would be an interesting subject of investigation to trace the source of the materials of the gravel on which our city is built. Everywhere of a red color due to the peroxidizing of the iron of the rocks from which the gravel has been derived, the basis of this latter is mainly siliceous. Many of the siliceous pebbles, from a small size to boulders approximating a ton in weight, appear to have been derived from the Potsdam sandstone, north of the city. They commonly have the same quartzite constitution; and in their irregularly rectangular and rhomboidal form, with borders and angles rounded by attrition, they exhibit the jointed condition of the Potsdam rocks. In earlier days when he learned that quartz belonged to the rhomboidal system, but exhibited no disposition to cleavage, he thought that the rhomboidal quartz pebbles of our gravel were examples showing a tendency to crystalline cleavage. Some of the quartzite pebbles, like portions of the Potsdam rocks, are of so compact a character, and banded in structure, that when polished they look like chalcedony, as exemplified by a specimen picked up on the Delaware shore.

Other pebbles of milky, smoky, and other quartz appear to have been derived from quartz veins of our neighboring gneiss rocks.

Black pebbles found in the gravel used in the construction of the bed of the junction railroad just north of the city, and collected as specimens of basanite or touchstone, appear to be hornstone or chert, like that in the lower Silurian limestone at Easton. Numerous pebbles of the same kind are found on the Delaware shore at the latter place. Limestone itself appears to form no conspicuous element of our gravels. Though abundant in the same sources of supply of the common ingredients of the gravels, its fragments have been completely dissolved away. Occasionally he had seen in the interior of a freshly broken pebble of black hornstone, such as one presented this evening, minute rhombohedrons of calcite, while on the exterior minute cavities of the same form show where similar crystals have been dissolved.

Pebbles of red sandstones and shales are frequent elements of our gravel, and have evidently been derived from the triassic rocks, so abundantly exhibited north of the city. Pebbles of compact quartz conglomerate are less frequent, and may probably have been derived from the same source, or perhaps from the coal measures farther north.

Irregular pebbles of various sizes, of a variety of granite, consisting of quartz with conspicuously large crystals of muscovite mica, occur in some localities, as in West Philadelphia, but a similar rock in place is unknown to him. The exposed sides of the mica crystals, worn into hollows of the quartz, appear so compact,

that one would hardly suspect their character without seeing the cleavage surfaces.

Fossils of any kind are extremely rare in the gravel of our immediate vicinity, and in the course of a lifetime he had picked up less than half a dozen quartzose pebbles pseudomorphic of a coral like *Favosites*, and with some obscure brachiopod impressions.

In the locality, from which the jointed specimens of quartzite of the Potsdam sandstone presented this evening were collected, he looked in vain for *Scolithus linearis*, viewed as a characteristic fossil of this formation. Some miles further off, near Sheridan Station, where an exposure of the same rock was less metamorphosed, and in part consisted of friable sand, he picked up a single specimen which contained the fossil.

JANUARY 10, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

Three more Fresh-water Sponges.—Mr. EDW. POTTS had described in the Proceedings under date of July 26, 1881, a new species of *Carterella*, *C. latitenta;* his later identified findings during that year are here mentioned.

MEYENIA CRATERIFORMA. This sponge, first found during September, 1881, in the Brandywine, near Chadd's Ford. is of very delicate structure. Its framework of skeleton spicules is exceedingly meagre and slightly bound together, scarcely amounting to a system of meshes and polyhedral interspaces as in most other sponges; and as a consequence we find the numerous small white statospheres lying in recesses far larger than themselves, freely exposed to view from the upper or outer side of the sponge. This trait is only seen in the thinnest of encrusting sponges.

The skeleton spicules may be described as acerate, gradually sharp-pointed, sparsely and very minutely microspined. With these were mingled smaller and more slender forms, which may be an earlier stage of the same, or perhaps are dermal spicules; but beside these may be seen upon the undisturbed surface of the sponge two other forms—one, cylindrical, slender, with truncate ends—the other similar in all respects to the long birotulates which surround the statospheres. The last have most probably been misplaced from their normal position.

The birotulate spicules surrounding the statospheres, as compared with those of any other described sponges, and with the diameter of their own rotules, are relatively very long. The diameter of the completed statosphere is to that of the contained chitinous body, about as 10 to 7, and the diameter of the rotules, while per-

haps double that of the shaft, is only from one-fifth to one-seventh of their length. A number of long, sharp spines occur near each extremity of the shaft. These birotulates are disposed, as is usual, very regularly and densely upon the surface of the chitinous body; one end of each being thus supported, the other forming a second or outer coat or surface. One peculiarity, however, of their arrangement has suggested the specific name now given. In most other species the length of the foraminal tube is fixed, or approximately indicated, by the thickness of the spiculiferous coat, which closes up around and against it. In this, however, on account of the unusual length of the spicules and their necessary radial direction, a space is left about the foramen, in the centre of which the tubule appears as an elongated cone; the whole having the appearance of a volcanic crater. In mounted specimens, probably as a result of violence in making sections of the statoblasts, these spicules frequently deviate from a direct radial position and cross each other's lines in a curious manner. This sponge has also been found in the Schuylkill River and in some of its smaller branches.

Heteromeyenia Ryderii. This beautiful green sponge has, as yet, only been found in a branch of Cobb's Creek, a small stream whose waters reach the Delaware River below Philadelphia. It occupied the upper surface of large stones in the bed of the stream; some of the patches being four or five inches in diameter and about one-fourth of an inch thick. The surface is somewhat irregular, occasionally rising into rounded lobes. The efferent canals are deeply channeled in the upper surface of the sponge; five or six sometimes converging to a common orifice.

The skeleton spicules are stout, cylindrical, slightly curved, gradually sharp-pointed, conspicuously spined, excepting at the extremities; spines conical, sharp-pointed; when largest often curving forward or towards the adjacent ends of the spicules. As is generally the case with spined skeleton spicules, they are but slightly fasciculated; being mostly arranged in a simple series, single spicules meeting or diverging from other spicules, thus forming a delicate network, supporting the sponge flesh. With these are mingled a few, more slender, smooth spicules which may be immature, or the true dermal spicules of the sponge.

The statospheres are numerous, rather small, surrounded *first* by a series of birotulates, short, stout, the rotulæ about equal in diameter to the length of the shaft. The shafts are cylindrical or somewhat wider toward the rotules, having frequently one or more long spines near the centre. Margins of the rotulæ marked with an infinity of shallow cuts not amounting to notches.

The *second* series of birotulates, which, more than in either of the other species of this genus, marks this as a deviation from the familiar *Meyenia* type, are very different from the first. They are nearly double the length of the former, much fewer in number, rather regularly interspersed among them; the rotules are repre-

sented by six, eight or more short recurved hooks, at each end of the shaft, which is cylindrical and studded with numerous spines, equal in length to the hooked rays of the rotulæ, and curving like them from the extremities. This species is respectfully dedicated by the discoverer to his friend, Mr. John A. Ryder, in acknowledgment of much excellent advice, assistance and encouragement.

Tubella Pennsylvanica. The genus *Tubella*, as established by Mr. H. J. Carter, Feb. 1881, was represented by four species, three originally described by Dr. Bowerbank (as Spongillas), and one by Mr. Carter—all collected in the Amazon River, South America. It does not appear that any have been described from other localities. It was therefore with much pleasure and some surprise that while examining material collected at Lehigh Gap, Pa., in November last, Mr. Potts came upon undoubted specimens of the same genus. It differs from *Meyenia* in the fact that the rotulæ of the spicules surrounding the statospheres are of unequal diameters; the larger one being placed next the chitinous coat. This species, whose peculiarities do not tally with those of any of the four above mentioned, may be thus described:

Sponge minute, encrusting, thin; the skeleton spiculæ arranged in a simple series of single non-fasciculated spicules, in the interspaces of which the statospheres are abundant.

Skeleton spicules very variable in size and shape, but all entirely and coarsely spined; rounded or abruptly pointed at the extremities.

Dermal spicules absent or undetermined.

Statospheres, numerous, small; granular coating thin but extending to or somewhat beyond the outer ends of the birotulates. Length of the inequibirotulates about equal to the diameter of the larger disk, which is placed against the chitinous coat. Margin of larger disk generally entire, sub-circular; outer surface flat, table-like, the margin sometimes slightly incurved. This surface is not infrequently warped or twisted into an irregular outline. The outer disk, in the great majority of cases, is about one-fifth the diameter of the inner, but varies from, say, one-sixth to equality, which is, however, rarely observed. Its margin also appears to be generally entire, but it is undoubtedly sometimes divided into six or eight rays. The inner surface of the larger disk is also occasionally marked with rib-like rays and still more rarely the margin between the rays is wanting.

These, as before stated, are all the species whose novelty has been definitely determined; but amongst the large amount of material collected are doubtless others, belonging to the genera *Spongilla* and *Meyenia*, whose distinguishing peculiarities are less obvious, and where close study will be needed to define them.

JANUARY 17, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

The following papers were presented for publication :

" New Crinoids from the Rocks of the Chemung Period of New York State," by Henry S. Williams, Ph. D.

" The Species of Odontomyia found in the United States," by Dr. L. T. Day.

" A New Station for Corema Conradii," by Aubrey H. Smith.

JANUARY 24, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-four persons present.

The death of M. Jules Putzeys, a correspondent, was announced.

The thanks of the Academy were ordered to be forwarded to Mrs. S. J. Haldeman Haly, for the gift of a portrait in oil of the late Prof. S. S. Haldeman, by Waugh.

Notes on Monazite.—Prof. GEORGE A. KÖNIG announced the identification of *Monazite* from the mica mine at Amelia Court House, Va. It has occurred in several large masses, from fifteen to twenty pounds in weight. One in the collection of Mr. C. S. Bement exhibits two crystals, monoclinic combinations of $P\infty \,.\, \infty P \,.\, \infty P\infty$, with sides over 5 inches in length. Such gigantic masses of this rare mineral have not heretofore been reported. It occurs together with equally huge crystals of microlite, fine crystals of columbite, of manganese tantalite, amazonite, albite, apatite, smoky quartz, and beryl; of the last mineral a crystal was found, 25 inches in diameter and over 12 feet long. This monazite was supposed to be microlite or scheelite. Two varieties have been identified by the speaker; one possessing an amber or brown color (transparent finely blood-red), and giving a straw-colored powder like microlite. The other variety is gray, with honey-yellow color in thin splinters, and yields a greenish gray powder; of the former the specific gravity is 5.402 and 5.345; of the latter it is 5.138.

When finely pulverized and mixed with two to three parts of

concentrated sulphuric acid, the mineral is decomposed very quickly as soon as the temperature is brought to the boiling point of sulphuric acid. The mass becomes a dry paste and dissolves in water. The solution is turbid from a quantity of basic phosphates, varying between two and eighteen per cent., according to the excess of acid present.

The acid solution may be boiled without the forming of a precipitate; thorium is therefore not contained in the mineral. Two determinations of the phosphoric acid gave 25.82 and 26.3 per cent., one being by phosphomolybdic acid; the other in the usual manner, after precipitating the bases first by oxalic acid, and the filtrate by ammonic hydrate. Fluorine is not present.

The following is given as a preliminary result, pending the tedious separation of the oxides:

$(Ce, La, Dy, Y)_2O_3$	=	73.82
$(Y, Fe, Ca)_2O_3$	=	1.00
P_2O_5	=	26.05
Volatile by ignition	=	0.45
		101.32

Supposing the oxides to be all cerous oxide, or in other words having the atomic weight of 92, the highest of the group, then the ratio obtains

$$P_2O_5 : 3\,CeO = 1 : 3.75,$$

which is not reconcilable with a normal phosphate.

The speaker suggests, therefore, the possible presence in the group of a metal with a much higher atomic weight than cerium. He is engaged at work with a large enough quantity of the oxides to decide this question in time.

JANUARY 31.

The President, Dr. LEIDY, in the chair.

Eighteen persons present.

Messrs. Wilson Mitchell, Chas. H. Hutchinson, Rev. W. G. Holland, Able F. Price, Alfred C. Harrison and Robt. B. Haines were elected members.

Dr. A. Baltzer, of Zurich, and Prof. Robt. Collett, of Christiania, were elected correspondents.

The following were ordered to be published:—

NEW CRINOIDS FROM THE ROCKS OF THE CHEMUNG PERIOD OF NEW YORK STATE.

BY HENRY S. WILLIAMS, PH. D.

Hitherto the rocks of the Chemung period have furnished only imperfect traces of crinoids. Joints of the stems are frequently met with, in some places in great numbers, but we find mention of only three crinoids in condition sufficiently perfect for specific identification.

Cyathocrinus ornatissimus was described by Professor Hall in 1843 (Geol. Rept. of 4th Dist. N. Y. State, p. 247), from the Portage group at Portland, shore of Lake Erie, N. Y., but the description and figures leave the generic and family relations of the species in doubt, and we find no mention of the name in the exhaustive "Revision of Palæocrinoidea," of Wachsmuth and Springer, 1879–1881.

Taxocrinus (*Forbesiocrinus*) *communis* Hall and Whitfield, is recognized in a specimen from the Chemung group at Forestville, Chautauqua Co., N. Y. (see Palæontology of Ohio, vol. ii, p. 170). The original locality for the species is the shales of the Waverly sandstone of Richfield, Summit Co., Ohio.

A third species, *Platycrinus Bedfordensis* Hall and Whitfield, is described from the upper part of the Erie shales of Ohio, which are regarded by some good authorities as equivalents of the Portage and Chemung rocks of New York. These three are the only crinoids specifically identified from rocks of the Chemung period, or their equivalents, up to the present time.

The specimens from which the following species have been determined are mostly in the condition of moulds from which the original substance of the fossil has been entirely removed, and in such cases, casts of wax or gutta percha have been used in the description of the species.

In a few cases the material is in such an imperfect condition that a proper specific diagnosis is impossible, and accordingly no specific name has been assigned, although mention is made under the generic name of such new characters as could be observed.

In other cases a large number of individuals has been found in a single locality, among which certain variations are noted, and

by comparison of all the specimens these variations are found to be pure variations and not marks of distinct species. Crinoids are generally so rare in individual specimens that it is believed that any contribution to our knowledge of the direction and extent of the variations among the individuals of a common species is of value to palæontologists.

The author expresses his thanks to Mr. Charles Wachsmuth for valuable suggestions and assistance in the identification of genera, and to Profs. John M. Clarke and S. G. Williams for the loan of specimens.

The types of the species, not otherwise designated, are from the author's collection, and will be placed on deposit in the museum of Cornell University, Ithaca, N. Y.

Poteriocrinus Cornellianus n. s. Pl. I, figs. 1, 2 and 3.

Calyx cup-shaped; arms very long; stem pentagonal and expanding at the top, under the calyx.

Underbasals small, difficult to distinguish from the final segment of the stem; junction between the several plates indistinct and in line with ridges of the stem.

Basals large, hexagonal, height and breadth subequal.

Radials large, broad, longitudinally convex, and incurving toward the vault, the edges of two adjacent radials forming a deep groove which terminates upon the upper part of the basals. The broad convex ridge, which begins on the radials, is continued in the brachials and arms up to the first bifurcation, and is in direct line with the five angular carinations of the upper part of the stem. The upper margin of the radial, straight, broader than the first brachial.

The radial is succeeded by a single series of eight (or nine) plates, of nearly uniform size, and dorsally with no lateral expansion, strongly convex, the last plate angular above, and presenting two oblique faces from which proceed two smaller arms. These arms bifurcate a second time in the course of their length. The general appearance is that these first eight plates above the radial are brachials. But, we observe, from the ventral part of the sides of each of these plates arise pinnules on alternate sides, beginning with the third or second plate of the series.

If, therefore, we regard the presence of pinnules as a mark of the arm-plates, in distinction from brachials proper, we have

here two or three brachials followed by a single series of arm-plates, six or seven in number (the number of these plates varies for the rays of a single specimen), with strong pinnules from each plate; from the last of this series branch off two subequal rays which again bifurcate.

The arms above the bifurcation are long and thickly beset with pinnules, one from each joint; occasionally a plate is intercalated without a pinnule, but the pinnules retain their alternate order.

In the middle and upper part of the arm the joints are somewhat produced on the side where the pinnules arise. Anals, three within the calyx; the lowest touches two basals, the right posterior radial and the second and third anals. The second anal lies upon the left of the first and touches the left posterior radial. The third anal is directly above the first, and touches the radial on the right, the second anal on the left, and is succeeded by a series of plates very similar (on the dorsal view) to the lower arm-plates, but with no pinnule and with straight articular faces. This is the ventral tube. This ventral tube is very long, apparently as long as the arms, but more even in size throughout.

In the typical specimen, what is preserved of this tube is one-third the length of the arms; laterally it is beset on both sides by a fringe, about the width of the plates themselves, of narrow ridges and furrows perpendicular to the axis of the tube. There are four to six of these furrows in the length of each plate, and they continue uninterruptedly the whole length of the tube. In another specimen the tube has been preserved lying mainly outside the arms, and thirty-one plates can be distinctly seen, making a tube whose length is six times the diameter of the calyx; the final plate is about half the size of the first one. A study of the specimens at command—although all but one are in the condition of moulds in fine sandstone from which the original material is entirely removed, has enabled us to make out the general external details of structure of this "tube." (Pl. I, fig. 3, *a*, *b*, *c*, *d*.)

The dorsal aspect is that of a cylinder, from a little below the centre of which extend outward and downward lamellæ which on each side are continuous; the junction at each joint of the plates is not visible, and transversely they are marked by narrow furrows. A section shows these fringe-like lamellæ to be lateral expansions of the axial plates, thickened at the outer margins and on the ventral side terminating at a narrow, medium, longitudinal

keel, which appears to be composed of two series of minute plates alternately arranged. The transverse striæ do not continue over the outer margin to the ventral side, but reappear in the furrow at the base of the ventral keel.

This is all that can be determined from the specimens, which show only the outside cast of the tube. Whether the transverse striæ are marks of external furrows, or of narrow perforations, or whether this be the whole of the tube, which was hollow, or an axis upon which softer tissues were engaged, are indeterminate from these specimens.

Dimensions.—Stem, diam. at top, 3.0 mm., below, 2.8 mm.; calyx, diam., 7.0 mm.; arm at base, diam., 2.0 mm.; primary radial series, length, 5.1 mm.; arms, length, 45.0 mm.; arms, first five joints at base, 6.–6.6 mm.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, 200 ft. above base.

One of the finest specimens of this species was collected by Mr. A. H. Cowles (C. U., '82), of Cleveland, Ohio, and presented to the author. It is taken as the type of the species.

The species is not uncommon, in the condition of stems and fragments, in Cornell University quarry, and in the same stratum at other outcrops, but the heads or even arms are very rare.

[1] **Poteriocrinus** *sp. prima*).

Two nearly perfect arms were found by the author on a fragment of rock, from cliffs of the upper Portage, which differ from any species known, but are not enough for specific diagnosis. The size and general appearance are those of *Poteriocrinus Cornellianus*, but it differs in the arrangement of pinnules, which appear regularly on each side from every fourth joint.

The pinnules are shorter and more slender than those of *P. Cornellianus.*

Locality.—Ithaca, N. Y.

Horizon.—Portage group (?); from slab not in place but probably from this formation, or just above.

[1] To avoid the necessity of establishing new specific, or varietal names upon inadequate evidence, use is made of the denominations *species prima*, *sp. secunda*, etc., under the appropriate genus, and *varietas alpha*, *var. beta*, etc., under the appropriate species as a means of designating new facts, whose taxonomic relationship cannot be satisfactorily determined from the material at command.

Poteriocrinus Clarkei n. s. Pl. I, fig. 4.

Calyx obconical, small, gradually expanding from the top of stem, which also gradually expands and the calyx continues evenly the rate of increase in size begun in the stem.

The radials are very convex in the centre, making a conspicuous enlargement at this point.

Underbasals of medium size, pentagonal, as high as wide.

Basals large, hexagonal, higher than wide, and twice the height of the underbasals. Radials of medium size, truncate above, irregularly pentagonal, smaller than the basals, wider than high, externally quite gibbous.

Brachials, two for each ray.

The first brachial short, cylindrical, with a straight margin above and below, height and width equal, much narrower than the radial; second brachial cylindrical, and at the base the same size as the first brachial, but near the top it suddenly expands to nearly double width, angular above, bearing two arms which do not bifurcate. In one specimen one of the second brachials bears three arms each of equal and normal size.

The joints between the primary radial plates gap, as do also, in some specimens, those of the arm-plates.

The brachials are free, parallel, and separated by a space as great as their diameter.

The surface of the calyx is marked by two rows of depressions; the first is elongate, longitudinally, its bottom lies along the suture between contiguous basals, takes in the point of the underbasal and the lower part of the radial; near the top of this groove is a horizontal ridge not reaching the general surface, but uniting the two walls of the groove, and it is more prominent in some specimens than in others.

In the second row, the depressions are smaller, triangular, pointed below, and have their centres over the angle of meeting of the basal and two approximate radials; each cavity extends upon the edges of each of these three plates.

Stem above pentagonal with thin disks, below gradually becomes cylindrical, and the disks elongate till their length equals half the diameter, are not convex but form a smooth cylindrical stem; from this part cirri are frequent, standing at right-angles to the stem.

Anals not known.

This species resembles *Pot.* (*Scaphiocrinus*) *Whitei* Hall, '61,

p. 306, but differs in the longer body, column more rapidly expanding at the top, larger calyx, the basals being larger in proportion, and in the presence of two brachials instead of one; also, the arms do not branch, so far as determined from the specimens, and the plates are not conspicuously prominent at the offset of the pinnules. The surface markings are much alike in the two species, but there are several other species similarly marked.

Dimensions.—Calyx, height, *a* 4.5 mm., *b* 4.4 mm.; width, *a* 5.1 mm. *b* 5 mm.; stem, diam. at base of calyx, *a* 2.4 mm., *b* 2.4 mm.; diam. lower down, *a* 1.4. mm.; primary radial series, height, *a* 5.2 mm., *b* 4.1 mm.; first brachial, diam. *a* 1.3 mm., *b* 1.2 mm.; first arm-plate, diam., *a* 1.1 mm., *b* 0.9 mm.; first five arm-plates, length, *a* 7.9 mm.

Locality.—Haskinsville, Steuben Co., N. Y.

Horizon.—Chemung group.

Collected by, and named for, Prof. J. M. Clarke, of Smith College, Northampton, Mass.

Poteriocrinus Clarkei, var. alpha n. v. Pl. I, fig. 5.

This variety is based upon the impression of part of a calyx found by the author at Ithaca, N. Y., in the lower part of the Chemung group.

It is about twice as large as the Haskinsville specimens, and the pittings of the surface are more strongly marked. The cross-bar in the upper part of the long grooves is particularly strong in comparison, but in shape and proportion of plates, the differences are so slight that we provisionally regard this as a variety of *P. Clarkei.*

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, lower part.

Poteriocrinus (Decadocrinus) gregarius n. s. Pl. I, figs. 6, 7, 8.

Underbasals minute.

Basals hexagonal, twice the size of the underbasals, as wide as high, the angles not sharply defined.

Radials about same height as basals, but broader and pentagonal, with the upper margin only slightly concave.

First brachial four-sided, longer than broad, and expanding toward the top, the upper margin conspicuously concave; base, same width as upper edges of radial.

Second brachial pentagonal, base convex and narrow, breadth

increasing to the top, where the width is equal to the total height of the plate, the two upper edges standing obliquely at about a right-angle, and subconcave.

Surface of calyx and arm-plates smooth and gently convex.

The rapid enlargement of the consecutive series of plates up to the brachials forms a low, expanded cup. The first plates of the arm are a third smaller than the terminal part of the stem just under the calyx.

The arms are long, ten in number, and do not branch; each arm-plate bears a pinnule. Pinnules are arranged alternately on each side of the stem, and occasionally a plate appears without pinnule, but the alternate order of the pinnules is not broken. The first five or six arm-plates are cylindrical, about the length of the last brachial, and, dorsally, show little extension, either laterally, or longitudinally at the point where the pinnules are attached, but after the fifth, the side from which the pinnule starts is slightly higher and extends laterally more than the other. The centre of length of the arm of the fully developed individual is at the tenth or twelfth plate, and here the plates are a third longer than their average diameter, and the pinnules are strong, gradually tapering to a point and composed of ten or twelve plates (or six to eight in the shorter pinnules); the first one is about half the size of the base of the arm-plate, from which it springs.

The arms are spreading, and an occasional specimen is found spread out radiately upon the surface of the slab.

The anals, and succeeding plates of the ventral tube, are not apparent on all specimens, but from examination of all the material at hand, we conclude that the arrangement of the proximal plates of the series is that normal to the genus *Poteriocrinus*, as defined by Wachsmuth and Springer, but the origin is frequently higher up in the calyx. In several specimens the anals do not reach the basals, but begin on the slopes of the two adjoining radials, which meet under them; but one specimen, which appears very well preserved, without distortion, has the normal arrangement of anals, three plates being in contact with calyx plates; the lowest lies a little to the right, between the adjacent, upper, sloping edges of two basals; above these anals can be distinctly seen, three or four plates in each of the two series of the ventral tube. The irregular position of the anals among the calyx plates possibly may be accounted for by distortion of the

specimen by pressure, but this is not self-evident, but inferred to explain what appears to be abnormal. Attention is drawn to the fact to show that species or genera established upon single or few imperfect specimens are not always to be relied on.

The stem is composed of discoid segments, externally convex and serrate at their union; arranged in two sets, one thinner than the other, in alternate order. The difference is greatest near the base of the calyx, where also the plates are thinnest; the thickness (or length) of the individual joints increases with distance from the calyx; the size of the stem slightly diminishes, and the difference between the two sets becomes obliterated, until the joints reach a length equal to their diameter, and the serrate union is inconspicuous, the outer surfaces becoming very convex. This latter is the common character of the central part of the stems, the joints being subglobular and of uniform size. Slender cirri proceed from all along the stem; they have been observed within an inch of the calyx, and are generally found rather closely coiled at their ends.

The upper part of the stem appears slightly pentagonal, but the angles are rounded and within an inch of the base of the calyx all trace of them is lost.

Dimensions of type specimen—which are a little greater than for the average of the specimens examined: Stem, diameter, 1.3 mm.; calyx, width, 2.3 mm.; arms and body together, total length, 21.6 mm.; primary radial series, height, 3–3.3 mm.; second brachial, width, greatest, 1.4 mm., average, 1.2 mm.; first five arm-plates, length, 4.1 mm.; second five arm-plates, length, 5.1 mm.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, 130 feet above base.

Three varieties are noted among the numerous specimens and fragments taken from the same stratum with the type specimen.

Var. *alpha* is distinguished by its smaller size, and the arms shorter, and composed of fewer, more slender plates.

Those characters of the stem, peculiar to the terminal portion, just under the calyx, are seen for only a very short distance.

The calyx and its plates do not differ, to any appreciable degree, from those of the specific type, in number, arrangement, relative size or shape.

Var. *beta.* The calyx is large, the plates well developed, the stem as large as in the typical form, and up to the base of the

arms this variety appears identical with the type of the species, but the arms are exceedingly short—not more than six plates appearing in the longest arm preserved.

One of the arms begins with two full-size plates, starting out, and in shape, like the typical form, but these plates are followed by three very slender plates, the base of the first not filling completely the facet at the top of the preceding one. The arm adjoining it has one normal-sized plate, followed by four slender plates. The other arms, as far as they can be examined, show a like arrangement, and the explanation is unavoidable, that the original arms were broken off, and were being replaced by new arms not fully developed when growth and life were stopped and the hard parts buried, and thus preserved to tell the story.

Var. *gamma*. A third variety is worth mentioning. In general characters it corresponds with var. *alpha*, but differs conspicuously in the plates of the ventral tube. At the base the anals are arranged as in the normal specimen, while the upper part appears to have special development.

There appears on the right side of the normal series of anal plates, beginning about half way up, a third series of plates about the same size as those at the corresponding height in the other series. The series, beginning lowest down, thus becomes the central one at the top, and eight plates can be counted in it. The lateral series have fewer plates, and the upper part loses itself in minute granulations at the base of the arms.

This species, of which many specimens were taken from a small locality, shows considerable variation in the length of the arms, in the number, relative size and shape of the arm-joints, in the character of the stem-joints at the base of the calyx and a short distance below until the normal characters of the stem are reached, and in the number and arrangement of the more distal part of the plates following the anals.

In these several respects the specimens under examination present hardly two which are uniform, and single specimens show more or less variation in the several rays.

There is also considerable difference among the specimens in the relative shape of the calyx and in the general arrangement of the arms, which is explained mainly by different degrees of, and direction in, compression since the specimens were buried.

The difference in the arms and arm-joints, we are led to believe,

is the effect of difference of age of the specimens. Thus, we observe, in this species, that the smaller specimens have less expansion of the stem at the top, the thin disk-like stem-joints are limited to a shorter distance downward from the calyx; the arms are shorter, the arm-plates fewer, and more slender, and apparently more uniform in size and shape than in larger specimens. In larger specimens, with the more fully developed arms, we observe the plates at the base are strong, length about equal to width; in the middle portion of the arm, they are more slender and only slightly diminished in diameter; in the upper part, the plates are of a medium length, but are strongly developed on the side from which the pinnule starts, and the stem becomes more or less zigzag in shape; with all these differences, the articular faces between the arm-plates show only very slight tendency to become oblique, a character so conspicuous in other species of the genus.

The pinnules normally start from every joint first on one side, then on the other, but frequently variation is seen in this respect, by the interposition of a plate without pinnule; in some cases this occurs frequently on a single arm, giving the appearance of pinnules from every other plate. In no case is the alternate order of the pinnules disturbed by this variation.

The differences in the plates succeeding the anals appear to be purely varietal, and associated with no concomitant variation in other parts, and may be due, in a measure, to differences in state of preservation.

The normal arrangement of anals is that of *Poteriocrinus*, as given by Wachsmuth and Springer, "Palæocrinoidea," '79, p. 110, but if we regard the calyx as stopping with the top of the radial we should have several cases where the anals are entirely above the calyx, as the lowest anal lies in the angle formed by the upper oblique faces of two adjacent radials. This accounts also for a narrower calyx.

Another specimen has but a single series of anals, resting upon the upper, sloping margins of the adjoining radials, thus reminding us of *Heterocrinus*. Still a third (see var. *gamma*) starts with two series of plates at the base, which appear to reach the basal series, and opposite the first brachial, a third series starts in on the side. Other specimens show the normal *Poteriocrinus* arrangement of anals, the first plate resting between the upper

angles of two basals, followed by two plates touching the adjacent radial, as explained above.

This species offers points of resemblance to several species of the genus, but it appears to be distinct, even allowing the great variation. As one feature after another is examined in the different specimens, such species as the Ohio *Scaphiocrinus subtortuosus* of Hall, the Burlington, *Scaphiocrinus fiscellus*, Meek and Worthen, and several others are recalled; but the species, taken as a whole, in its general features as well as in the details, appears most nearly related to *Poteriocrinus diffusus*, Hall, '62, 121, and *Pot.* ("*Scaphiocrinus*") *ægina*, H., '64, 57—the former from the Hamilton group of New York and the latter from the Waverly group of Ohio.

Prof. Hall has noted the resemblance of the two to each other; one point of difference is in the arm-plates. In the Hamilton species every second or third plate bears a pinnule, and "the intermediate joints are shorter than those bearing armlets."

The Waverly species bears pinnules from each plate.

The species under consideration shows considerable variation in this respect even on a single specimen. The writer has not had access to the types of the two species above referred to, but from study of the figures and descriptions, together with the fine series of specimens of *P. gregarius*, it would not seem unreasonable to expect that specimens may eventually be found uniting all three species into one.

Poteriocrinus (Decadocrinus) Zethus n. s. Pl. I, fig. 9.

Body turbinate, with two long, slender brachials to each ray. These long brachials, with the arms, form a narrow elongate head with subparallel sides.

Underbasals minute, height and width about equal. Basals ("subradials" of Hall), a little higher than wide, rounded hexagonal. Radials wider than high, rounded pentagonal, the upper edge nearly straight, but falling off a little at the corners, beyond the base of the first brachial, which is narrower than the greatest width of the radial.

Brachials, two for each ray, subequal in length, cylindrical, twice as long as wide, length of each about that of height of calyx; the second brachial expanded at the top with inclined faces for attachment of first arm-plates.

Arms short, slender, the plates few and fully twice as long as wide.

The arm bears a pinnule at the third joint; (or bifurcates at this point, the specimen is too imperfect to determine which).

Anals unknown.

Column rounded, relatively strong, not expanding under the calyx, composed of two kinds of joints, alternating regularly, from above, first a thin, then a subglobular joint, and not varying in size or proportion for the length of stem exposed.

Dimensions.—Diam. stem, 0.8 mm.; calyx, width, 2.2 mm.; calyx, height, 1.5 mm.; primary radial series, length, 3.5 mm.; second brachial, mean width, 0.7 mm.; first arm-plate, length 1.0, width, 0.3.

This species resembles *P. Nycteus*, Hall, '61, 120, but the brachials and arms are stronger, and the brachials longer in proportion to the calyx. The resemblance suggests the name for the species, *Zethus*, who was the grandson of *Nycteus.*

Locality.—Ithaca, N. Y.

Horizon.—? Portage group, from a loose slab near the the top of the Portage, and supposed to have fallen from the rocks just above where found.

In collection of Prof. S. G. Williams, Cornell University.

Taxocrinus Ithacensis n. s. Pl. I, fig. 10.

Body expanding moderately; calyx shallow, broad; arms strong, of medium length, the whole head rather slender for the genus.

Underbasals minute but appearing as a thin, irregular band above the last stem segment.

Basals small, low, subpentagonal.

Plates of the first radial series, strong, large, well developed.

Radials pentagonal, upper edge deeply sulcate, broader than high; articulation with first brachial narrower than the full width of plate; surface broadly convex.

Brachials, two for each ray. First brachial subquadrate, width and height about equal, wider at top than at bottom, upper margin broadly sulcate.

Second brachial, the largest plate of the body, expanding above, subpentagonal, upper margin angular.

Primary arm-plates, four (or rarely five) strong, about half the size of brachials; the arms branch twice (or three ? times); each branch of four or five plates.

Arm-plates convex, but not angular, about as high as wide; no

pinnules seen; each arm-plate deeply sulcate on its upper edge for articulation with the following plate, the upper angle produced ventrally so as to appear subauriculate on a side view.

Stem strong, round; the joints under the calyx thin and crenulate at margins; the thickness increases gradually for half an inch downwards, then there appear two sets, one thick, one thin; the thick plates increase in thickness and become strongly convex; the thin disks finally appear to drop out, and the main part of the stem consists of long nearly cylindrical joints, only slightly convex, and united by finely serrate margins. The root is a simple, low, conical expansion of the end of the stem, and is found attached to the shell of *Spirifer lævis*, in several cases.

Dimensions.—Stem (just below calyx), diam., 2.9 mm.; width of calyx, 5. mm.; primary radial series, height, 4. mm.; second brachial, width, 2.8 mm.; first four arm-plates, length, 4. mm.; total length of body and arms, 20. mm.

Locality.—Ithaca, N. Y.

Horizon.—Portage group, *Spirifer lævis* beds.

Taxocrinus Ithacensis. var. alpha n v.

This variety is about half the size of the typical form of the species occurring three or four hundred feet below.

The arms are shorter, and attain only the second bifurcation.

The stem, at the top, has but a few of the uniformly thin disks, the alternate sizes beginning to appear much nearer the base of the calyx (within a quarter inch) than in the typical form. Otherwise, the calyx—the shape and number of plates in the calyx and in the primary radials—the first series of arm-joints, four (rarely five)—the second series, four or five—their convexity, and all other characters observed (except the smaller, and slightly shorter, stunted form), are precisely as in the type specimens of the species.

In some specimens of this variety, one of the arms is observed to have but two primary radials, the other rays have three. This I can look upon only as a varietal character, as in the secondary series we generally see variation in each specimen from four to six joints.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, about three hundred feet above the *Spirifer lævis* beds of the Portage group.

Taxocrinus curtus n. s.

In general appearance this species resembles variety *alpha* of *T. Ithacensis*, but is still shorter, and the calyx is very low and widely expanded.

The underbasals do not appear on the surface.

The plates of the primary radial series are striate, or subcarinate along the centre, with faint parallel striations each side, and the surface indistinctly granular; total length of the three is once and a quarter the width of the second brachial.

Basals relatively smaller, about the height of the radial.

Radial very short, broad, sublunate.

First brachial subquadrate, height less than the width, which is less than the width of the radial.

The second brachial is the largest plate of the body, wide, pentagonal, with two broad, oblique edges for attachment of arms.

The arm-plates are less deeply sulcate at the upper margin than in *T. Ithacensis* or in the variety *alpha*.

Primary arm-plates, four, or three, convex, subcarinate. The central striæ, or carinations, are continuous from the brachials to the end of the rays, diverging at each axillary plate. The stem is composed of two sets of joints, the one thick, the other thin, from the base downward and it does not expand at the top as in *T. Ithacensis*. The very thin plates with crenulate edges, occurring under the calyx in that species, are wanting, as are also the extra large joints occasionally appearing along the upper part of the stem.

At first sight the types of this species appeared like extreme varieties of *T. Ithacensis*, in the line of var. *alpha*, but upon close comparison it is observed that not only are the arms shorter and of fewer joints, but the whole body is more stunted, and the primary radials, as a whole, and the individual plates composing them are proportionately shorter and wider than in that species, and the striation of the plates is not observed in any of the specimens referred to *T. Ithacensis*.

As fossils are defined, this is doubtless a distinct species, but it would not be surprising if a larger series of specimens should reveal the fact that the characters upon which it is founded are of no more than varietal value.

Locality.—Ithaca, N. Y.

Horizon.—Portage group, *Spirifer lævis* beds.

Melocrinus Clarkei n. s.

The shape of the calyx cannot be determined on account of the crushed condition of the specimens, but the shape and number of the plates agree so well with those of *M. Bainbridgensis*, H. and W., that it is probable that the shape was the same, *i. e.*. broadly turbinate. In size, also, the calyx agrees well with that species.

No underbasals appear.

The basals are low, wide and pentagonal.

The radials are more than double the size of the basals, height and width equal, or wider than high. The variation in the shape of this plate, in the several specimens upon the one slab, covers the extremes met with in the two species *M. Bainbridgensis* and *M. breviradiatus*.

The radial is followed by two brachials of smaller size, the first hexagonal, the second pentagonal and angular above, and each is about equal in height and width.

The second brachial supports two arm-plates (still within the calyx), nearly as large as the brachials, irregularly pentagonal and meeting at their inner edges.

Of the secondary radials, three are within the calyx, the second is about half as high as wide, the third is very short. The third pair of secondary radials together bear a strong arm, gradually tapering to a point, about three times the length of the calyx. It is broad, flattened on the back and longitudinally depressed along the centre, and is composed of a double series of very short plates, meeting at the centre and arranged in opposite (not alternate) order.

On the outer and ventral side the arm bears long, slender, cord-like branchlets, which appear to have fine thread-like appendages along their sides. In the central part of the arm these branchlets are as long as the arm itself. They proceed from every third arm-plate, instead of every fourth, as in *M. Bainbridgensis*, and the plates from which they appear are opposite each other, and their outer sides are lengthened slightly.

The interradials are apparently like those of *M. Bainbridgensis*, beginning with a large plate between the upper parts of two adjacent radials, followed above by two smaller plates, and these by more still smaller plates, the number or arrangement of which is not uniform.

The calyx-plates are marked by granulations over the central

portion, are rounded at the margins, which in some cases are elevated slightly above the central part of the plate, causing a depression, as in *M. Bainbridgensis;* other plates (even on the same specimen) are convex, as in *M. breviradiatus.* The rows of fine ridges, connecting the calyx-plates at their juncture, are very distinct in some cases, and do not appear in others. The former is a character of *M. breviradiatus.*

The stems are composed of alternately thin and thick plates, the relative order, or proportions of which, are not constant, even varying on the same stem when preserved for long distance.

This species is closely related to *Melocrinus Bainbridgensis*, Hall and Whitfield, 1875, from the Huron shale, Bainbridge, Ohio, and to *M. breviradiatus*, Hall (figured on a plate of "New Crinoidea, Pl. 1," which was published, with explanation of plates, in 1872), from the Hamilton group.

The study of the specimens (all on a single slab), from which the above diagnosis is made out, has revealed the fact that apparently all the characters distinguishing the two species just named are variable in those specimens. The arms must be excepted; none are known for *M. breviradiatus*, and those described for *M. Bainbridgensis* were not found attached to any calyx.

While, therefore, we retain a distinct specific name for the specimens under consideration, we are led to believe that examination of a larger series of specimens may make it necessary to unite these three species in one.

Locality.—Ontario County, N. Y.

Horizon.—Genesee slate (? Portage group).[1]

This species was discovered several years ago, and by Prof. N. T. Clarke, of Canandaigua, N. Y., was brought to the notice of Prof. James Hall, who gave it the name "*Ctenocrinus Clarkei*," in honor of Prof. Clarke. But as no description or figure was made of the species we publish it as new under the specific name proposed by Prof. Hall.

Among the material collected by Prof. John M. Clarke from

[1] [The specimen above described belongs to the fauna of the Hamilton (not Chemung) period.

A second specimen, which I have not seen, came from Portage rocks; and this second specimen, Prof. J. M. Clarke informs me, is apparently the same species but has never been scientifically identified.] —H. S. W.

the Chemung rocks at Haskinsville, Steuben Co., N. Y., are two species of *Poteriocrinus*, belonging to the type of *P. Cornellianus*, but evidently distinct. The specimens are so imperfect that a satisfactory specific diagnosis cannot be made out, but we will record the characters which can be distinguished.

Poteriocrinus (*sp. secunda*).

Stem at the top strongly pentagonal, carinate and expanding.

Calyx small, rapidly expanding. Arms large, and arm-plates convex.

Underbasals small, low, broad, arched above, subpentagonal.

Basals a little higher than underbasals, and twice as wide as high.

Radial twice as large as basal, broad, sublunate, with the points turned upwards.

Primary radials very large, nearly as wide as the calyx below the radials, composed of short plates with straight sutures and of at least seven plates; the specimen is imperfect just before the bifurcation.

There are small, deep pits in the calyx at the lateral and upper angles of the basal-plates as if their corners had been abruptly bent in toward the centre. The upper part of the stem and the numerous primary radials are features resembling *P. Cornellianus;* but the specimen is fully twice as large; the calyx is much smaller and expands more rapidly, and the pittings of the calyx are peculiar.

Poteriocrinus (*sp. tertia*).

Stem roundish, subpentagonal near the top, with cirri standing out obliquely and straight from the stem, of which several appear within an inch below the base of the calyx.

Calyx low, small.

Underbasals cannot be distinguished, but evidently present and small.

Basals about as high as wide and nearly as large as the radials.

Anals unknown.

Radials subpentagonal; the insertion of the first brachial occupies the full width of the plate. There are six plates in the primary radial series; pinnules appear from the plates above the third. The sixth primary radial (the fifth brachial) is angular

above and from it the ray bifurcates. On each side pinnules start from every alternate plate.

Pinnules short.

This resembles *Pot. Cornellianus*, but it is considerably larger, the stem is less strongly pentagonal at the top, and the primary radials are six, instead of eight or nine, as in that species.

The specimen is on a slab with *Dictyophyton.*

Locality.—Haskinsville, Steuben Co., N. Y.

Horizon.—Chemung group.

EXPLANATION OF PLATE I.

PAGE.

Figs. 1, 2 and 3. POTERIOCRINUS CORNELLIANUS 18

1. Anterior view; showing calyx and lower part of arms.
2. Anal view; showing anal plates and ventral tube.

3 *a.* Another specimen; showing long ventral tube, a part of the calyx and one of the arms running under the ventral tube.

3 *b.* Section of ventral tube, dorsal view enlarged.

3 *c.* View of transverse section of the ventral tube.

3 *d.* Ventral view of same; showing the short furrows or lamellæ extending from the ventral longitudinal axis only part way toward the edge of the lateral fringe-plates.

Fig. 4. POTERIOCRINUS CLARKEI 21

The *three* arms proceeding from one of the distal brachial plates is exceptional; generally only two are seen for each ray.

Fig. 5. POTERIOCRINUS CLARKEI var. ALPHA 22

Figs. 6, 7 and 8. POTERIOCRINUS GREGARIUS 22

Fig. 9. POTERIOCRINUS ZETHUS 27

Fig. 10. TAXOCRINUS ITHACENSIS 29

a. Head and upper part of stem. *b.* A few joints from the central portion of the stem. This is the general character of the fragments of stems. *c.* Base of the stem, with the disk by which it is attached; in this case to the surface of a *Spirifer lævis.*

Figs. 1, 6, 7 and 10 are enlarged about once and one-half, and figs. 3 *b, c, d* and 8 are twice natural size.

A NEW STATION FOR COREMA CONRADII, TORR

BY AUBREY H. SMITH.

This rare plant was formerly collected in the Pine Barrens of New Jersey, by Torrey and Knieskern. It is now lost from the places indicated by them, though diligent search has been made for it there by Messrs. Redfield and Parker.

It was at one time found on Long Island, but not of late years. It is probably extinct both in New Jersey and on Long Island.

It has been found on Cape Cod and on the Kennebec, New Bath, Maine, and in Newfoundland. Whether it is now to be found in these places or not I am not informed.

The specimens which I exhibit to-night were collected in the Palmaghatt Glen or Pass of the Swawangunk Mountains, by Mr. Edward A. Smiley, at my request, in October of the present year. His father, A. H. Smiley, the proprietor of the Minnewaska House, informed me in the preceding month of August, that there was a singular little plant, with the aspect of a very small cedar, growing on a ledge of rocks on the Palmaghatt, some two and a-half miles from his house.

From the rather inaccurate description of it given me by him and his son, whose intelligent curiosity had also been directed to the plant, I surmised that it might be *Corema*.

I therefore engaged Mr. Smiley at the first opportunity to collect, and send me by mail, specimens of it.

It grows, Mr. E. A. Smiley writes me, on the edge of a precipice of upper silurian rocks of Ulster County, in a very thin soil. In May next I hope to have from him specimens in flower and fruit.

The plant appears to be one of those which are verging to extinction, the conditions of its environment seeming to be against its prolonged life.

PROCEEDINGS

OF THE

MINERALOGICAL AND GEOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

1880–1881.

JANUARY 26, 1880.

Some New Pennsylvania Mineral Localities.—Mr. CHAS. M. WHEATLEY reported, through Mr. Lewis, the following localities not mentioned in Dr. Genth's Report on the Mineralogy of Pennsylvania: Jones Mine, Berks Co., Pa.; Aurichalcite, Melaconite, Byssolite. Upper Salford Mine, Montgomery Co.; Azurite.

Pseudomorphs of Serpentine after Dolomite.—Mr. H. CARVILL LEWIS drew attention to some specimens of associated serpentine and dolomite which he had found within the city limits, and which appeared to be pseudomorphs. He had found them in the Twenty-second Ward, on Paul's Mill Road, near the Wissahickon Creek. A range of serpentine and steatite here crosses the creek, being the same which crosses the Schuylkill at Lafayette and continues through Montgomery County in a southwestwardly direction. It here appears to conform closely, both as to strike and dip, with the adjoining gneiss, whatever its origin. All along its northern edge the steatite is filled with hard nodules of dark serpentine, which Mr. T. D. Rand has shown to be pseudomorphous after staurolite.[1]

At the locality mentioned, this peculiar rock contains veins or lenticular beds of massive, cleavable dolomite. This dolomite is frequently traversed in the three directions of its cleavage-planes by thin seams of serpentine, while irregular masses of steatite or serpentine also run through it or protrude into it from without. When the interpenetrating serpentine is in a thin seam it may frequently be observed to assume a pseudomorphic character. It may assume the shape and external characters of dolomite, while retaining the color and composition of serpentine. It then possesses both the rhombic cleavage-planes and the jointed structure of the dolomite, and often, also, its characteristic transverse striæ. In some of the specimens collected the serpentine presents a step-like appearance, and when it coats successively

[1] Proc. Acad. Nat. Sciences, 1871, p. 303.

alternate blocks of dolomite, rising one above the other, it might be compared to a flight of tiny white marble steps, covered by a green carpet.

At times, whole blocks of dolomite are replaced by serpentine. Transverse striæ have been noticed only on very thin seams, yet here they are quite as distinct as upon the adjacent dolomite. Rhombic cleavage-planes, however, are very common throughout the serpentine, although, unlike the dolomite, these markings are generally only superficial. In very exceptional cases the eminent rhombohedral cleavage of the dolomite is retained by the serpentine. While the serpentine has thus acquired the external form of dolomite, it possesses its identity as serpentine. When broken it shows the irregular or conchoidal fracture characteristic of true serpentine. When a fragment is immersed in warm acid, a momentary effervescence often takes place, owing to the adherence of thin scales of dolomite, as proven by the microscope.

No actual passage of dolomite into serpentine has been observed on the specimens collected. The two minerals are distinct. The line of demarkation between them is always sharp; pure serpentine lying in juxtaposition with pure dolomite. The dolomite is the white, glassy, cleavable variety, containing about one and one-half per cent. of carbonate of iron, as determined by volumetric analysis.

From the description which Professor Dana has given of the serpentine pseudomorphs found at the Tilly-Foster iron-mine,[1] it appears that in several particulars those of the Wissahickon are quite similar.

In the use of the term *pseudomorph*, it must not be understood that it implies an actual alteration. The specimens here described may be classed as *pseudomorphs by substitution*. It appears that the dolomite has not been altered into serpentine, but has been replaced by it. As is probably the case with all pseudomorphs by substitution, the original material is more soluble than that which is substituted. Whole rhombs of dolomite appear to have been dissolved and simultaneously replaced by the deposition of serpentine.

That this is a case of pseudomorphism by infiltration and replacement, is indicated by the fact that in one specimen a rhomb of dolomite is replaced by magnetic chromite. The chromite occupies the full width of the narrow seam of serpentine for a short distance, and was evidently deposited from the same solution which held the serpentine.

In discussing the origin of these and similar pseudomorphs, it is important to bear in mind the fact of the sharp juxtaposition of the two substances, and the consequent possibility of their having been formed contemporaneously. It must also be remembered that the dolomite, which contains the pseudomorphs of serpentine,

[1] Amer. Jour. Science, vol. viii, 1874, p. 371.

lies itself in a bed of serpentine, and that it is therefore possible that the pseudomorphs were formed at the very time of the original crystallization of the dolomite. If we grant that the dolomite, and the bed of serpentine which contains it, were formed simultaneously, it may readily follow that the minute pseudomorphous seams of serpentine *within* this dolomite were enclosed during the very act of crystallization of the dolomite. With this view, we might regard these pseudomorphs by substitution as having been deposited, not by an infiltrating solution from without, but by a solution which was being *expelled* from the interior of the dolomite by the crystallizing power of the latter. If such were the case, the serpentine would readily assume the *habitus* of the dolomite, and the same crystallizing force which caused the cleavage-planes and the transverse striæ upon the dolomite would superinduce them upon the enclosed serpentine.

Contemporaneous pseudomorphism implies a pseudomorphism by association. True pseudomorphism by substitution, like epigenesis, is subsequent. While not attempting in the present case to determine the relative time and, therefore, the kind of pseudomorphism, the foregoing remarks are offered merely as suggestions in reference to a subject already so fully discussed by eminent writers.

New Localities for Barite.—Mr. LEWIS contributed the following new Pennsylvania localities for barite:

1. Bridgeport, Bedford Co. It occurs here in small tabular crystals in red Catskill sandstone (No. IX).

2. Broad Top Mountain, Huntington Co. Thin transparent coatings of barite frequently cover the fossil ferns and calamites which occur in the carboniferous shales and fire-clay adjoining the semibituminous coal-seams of Broad Top Mountain.

3. Lancaster Station, Franklin Co. It occurs here in large white cleavable masses.

FEBRUARY 23, 1880.

New Localities for Chabazite.—Mr. LEWIS PALMER announced two new localities for chabazite. It occurs in red crystals in a hornblendic gneiss at Waterville, near Chester, and also at Upland, Delaware Co.

On a New Ore of Antimony.—Mr. H. C. LEWIS described an oxide of antimony found at Senora, Mexico, which he had been unable to identify completely with any known mineral. Under the supposition that it was a tin ore, it was sent to him by Mr. T. H. Shoemaker for examination.

The mineral generally occurs as a massive, compact, hard sub-

stance, with an imperfectly conchoidal cleavage and of a pale grayish yellow color. It also occurs as minute colorless octahedral crystals of glassy lustre. The crystals often occur in druses in the massive mineral, and are sometimes modified. Their form can only be distinguished with the microscope. Neither the crystals nor the massive substance show any colors in polarized light, and the mineral is therefore isometric. Special care has been taken to prove the identity of the octahedral crystals with the massive mineral. So far as could be determined with such minute crystals, their hardness and their behavior in the open tube were identical with the massive mineral.

The mineral here described has the following physical characters:

Isometric. Habit octahedral. Generally massive. Hardness, 6.5–7. Specific gravity, 4.9. Lustre of the crystals glassy; of the massive mineral sub-resinous or sub-vitreous. Color, pale grayish yellow. Streak uncolored. Transparent in crystals, opaque when massive. Fracture sub-conchoidal.

A thin section of the purest mineral examined under the microscope shows an entire absence of any foreign admixture. The structure is banded, the bands consisting of more or less opaque material, and the general appearance of the section recalling a section of muscular fibre. It has the following blowpipe characters:

On charcoal before the blowpipe, it is fusible with difficulty and decrepitates strongly. It gives a white coating of oxide of antimony, and fuses to a gray or bluish gray slag and is partially reduced to metal. With carbonate of soda on charcoal it is more readily reduced. In the borax and salt of phosphorous bead the slag dissolves and gives it generally a blue color, due to a trace of cobalt. In the closed tube it gives off water, decrepitates with violence, turns deep yellow when hot and becomes white when cold. It does not fuse or give a sublimate in either open or closed tube. When the slag formed by fusion on charcoal is moistened and placed on turmeric paper, it forms a brown stain.

The following are its chemical characters:

It is partially dissolved by digestion in concentrated hydrochloric acid, and by the addition of water to the yellow solution thus obtained white oxychloride of antimony is precipitated. It is decomposed with great difficulty, even after fusion with sodic carbonate and sulphur. On account of the difficulty of getting it into complete solution, no quantitative analysis has as yet been made. It has been found to consist mainly of oxide of antimony and to contain small percentages of lime, iron and water, and traces of arsenic cobalt, and lead. It has 3.1 per cent. of water. Until an exact analysis is made it will not be possible to determine its mineralogical equivalent.

Several tests indicate that the antimony exists mainly in the state of antimonious oxide. It differs from senarmontite and

valentinite in hardness, in fusibility and in solubility; from stibioonite in greater hardness, in its decrepitation, and in its occurring in crystals; from cervantite in its fusibility and in its behavior in the open tube; and from volgerite in the amount of water.

The massive mineral frequently contains crystals and small veins of quartz, and sometimes contains also small seams of a soft reddish yellow mineral which is probably stibiconite, a product of alteration.

Menaccanite from Fairmount Park.—Mr. JOHN FORD exhibited a fine specimen of menaccanite (ilmenite), found by Mr. G. Howard Parker in mica schist that had been quarried from the tunnel near Girard Avenue Bridge, Fairmount Park. Though associated with many others of like character, this specimen is probably the largest and most beautiful of any found in or near the locality named. It is quite lustrous in appearance, and measures about one-third of an inch in thickness by one inch in width. Its general form is that of an almost perfect half-circle, the whole being partly imbedded edgewise in a matrix of quartz.

It seems probable that the circular form of the crystal is due to its having been bent by the curving of the bed of schist in its earlier stages; but, of course, this can be little more than a supposition. The entire length of the crystal, measured around the curve, is about four inches.

MARCH 22, 1880.

On a Fault in the Trias near Yardleyville, Pa.—Mr. H. C. LEWIS remarked that it was not often that a section of a well-defined fault was exposed for study. Frequently a fault starts a line of erosion which obliterates all trace of it, and the actual junction of the faulted measures is either occupied by a stream or is so covered by talus that it can only be inferred from adjoining outcrops. He therefore thought that it might be of interest to describe a finely exposed fault which he had recently observed on the line of the Bound Brook Railroad.

Less than half a mile west of Yardley Station on the Bound Brook Railroad, a deep cut exposes a fine section of lower triassic shales and conglomerates. The fault occurs in about the middle of this cut. It may be seen on both sides of the railroad, but is finest on the north side. It is a fault between the lower white conglomerate and the overlying, but here adjacent, red shale. The fault runs north and south, or nearly at right-angles to the strike of the strata. The east end of the cut exposes conglomerate and sandstone, and the west end red shale, both of which are more or less decomposed and dip gently to the north. These formations are separated from one another by the nearly perpendicular walls of a trap-dyke, which occupies the line of fault.

The trap is entirely decomposed into a soft, clayey material of a black color, with specks of white, and is about 5½ feet in width.

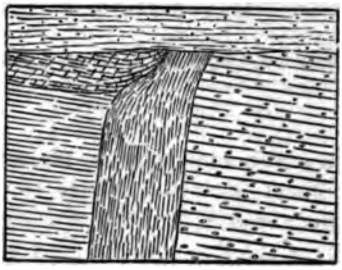


DIAGRAM OF FAULT NEAR YARDLEYVILLE.

The contact of the two differently colored formations with the black trap-dyke is very distinct, and is an instructive example of geological structure.

There has been apparently a downthrow of red shale and an upthrow of conglomerate, while an outburst of eruptive trap has forced its way along the line of fracture. It is of interest to observe that some strata of shaly yellow sandstone, overlying the red shale, have their edges *turned up* where adjacent to the trap, as though the fault had been caused by the pressure from below of the molten trap. That trap frequently exercises great mechanical force in its effort to break through to the surface, is shown by the fact that at several localities in Pennsylvania, the triassic shales in the neighborhood of a trap-dyke have their dip altered or even completely reversed. Near Taylorsville, for example, the writer has observed the dip of the red shales changed in the vicinity of a trap-dyke, from 20° N. 10° E., the normal dip, to 18° S. 80° W. Near Harleysville, also, a dyke below the surface has metamorphosed the strata into black argillite and reversed the dip to the south. It is probable, therefore, that the trap has been the direct cause of the fault which encloses it in the case here described.

MAY 24, 1880.

NOTES ON THE GEOLOGY OF RADNOR AND VICINITY.

BY THEO. D. RAND.

There has recently been published in the Proceedings of the American Philosophical Society (January to March, 1880; vol. xviii, No. 105) a paper read before the Society, January 2, 1880, by Charles E. Hall, on the Relations of the Crystalline Rocks of Eastern Pennsylvania, some of the conclusions in which so differ from my own observations that a statement of the latter may not be without interest, especially as regards the middle serpentine belt in Radnor, which I have been studying for some time.

Mr. Hall describes seven series of rocks and two serpentine horizons. Of these I have carefully examined but the second, fifth and seventh series and the serpentines. The second, he describes as "A series of syenitic, hornblendic and quartzose rocks, extending westward from Chestnut Hill, and covering a greater part of the northern portion of Delaware County."

These rocks, locally known in Delaware County as "Radnor Rocks," from their prevalence in that township, are in abundant outcrops in very many places, perhaps the most remarkable of which is a hill in the form of a truncated cone, perhaps 400 × 800 feet on the summit, with steep but not precipitous sides, 80 to 100 feet in height, situated in Chester County nearly south from Reeseville, and a prominent object in the landscape. North of these rocks occur those called by Prof. Rogers in the Geology of Pennsylvania, vol. 2, p. 72, primal older slates, and well described by him as follows:

"Metamorphosed with characteristic white streaks of imperfectly crystallized feldspar, and dark hornblendic material, with roundish specks of semicrystallized feldspar."

They are in fact gneiss, composed generally of thin layers of most varied character, feldspar being abundant, mica, hornblende and quartz varying in the layers from almost nothing to great abundance of one or the other; and many of these layers often appearing in an inch, giving at times a schistose character to the rock, but the mica or hornblende never so abundant that it can

properly be called schist. The minerals composing this rock closely resemble those of the gneiss on the south; so close is the resemblance of certain strata in the one, to some of the other, the difference being chiefly in mode of aggregation, that it seems to me not improbable that the northern are but upper strata of the southern gneiss.

The fifth group of Mr. Hall is described as "Hydromica schists, quartzose schists, chloritic schists and occasional beds of quartzite and sandy beds, and serpentines;" of which he says, page 436: "These are the Hudson River shales and flank the Chester Valley on the south * * * the entire length of the Valley. They extend south to the syenitic rocks of the second group." Mr. Hall does not mention the schistose gneiss, nor is it possible to include it under his description of either the second or fifth groups which he places in contact. On page 441 he says: "The serpentines of Radnor Township, Delaware County, and those of eastern Willistown, east and west Goshen, are undoubtedly altered beds of the South Valley Hill slates or Hudson River slates. They lie unconformably upon the syenitic rocks of the second group." There are, as I have heretofore shown (Proceedings Acad. Nat. Sci., Philada., Nov., 1878), three approximately parallel beds of serpentine in Radnor Township. Presuming, as seems from the connection with the Chester County outcrops, that the middle and most conspicuous belt is intended, I cannot agree with Mr. Hall in his conclusions.

This middle belt is the largest of the three, and north of the syenite hill appears first on the Mattson's Ford or township line road, on the westerly side of a small affluent of the Gulf Creek, one-quarter mile northeast of Radnor Station, with a strike nearly E. and W. The serpentine forms a large hill, which begins abruptly and closely resembles in lithological character that of the Lafayette or Rose's quarry belt. The next or second outcrop is nearly west of this and is inconspicuous. The third, northwest of Radnor Station, is about 1000 feet in length. Its centre is nearly due west from the first; the strike is not far from N. 60 E. This outcrop ends abruptly. About 400 feet north is a small outcrop appearing as if the end of the ridge had been removed 400 feet northward. Beyond this I believe no outcrops have been described until we reach those near Paoli, but several exist: the fifth, nearly S. from Eagle Station, small and the strike indistinct;

the sixth, S. W. of Eagle, is S. 70° W. from the fifth, with a strike S. 40° W., dip about 75° to 80° S.; the seventh is nearly due W. from the fourth, its strike N. 50° to 60° E.; the eighth is a little S. of W. of the seventh, strike and dip not distinct; the ninth, that crossing the road running S. E. from Berwyn, and about a mile from that station, is at its eastern end S. 10° W. from the eighth, its strike is S. 40° W. The outcrop near Paoli is nearly W. from this, and extends thence as the wide and well-known belt passing one mile north of West Chester.

Now, examining the first outcrop, that on the Mattson's Ford road, we find on the S. the rocks of group one without doubt, but on the N. we find almost identical rocks—hornblendic gneiss, porphyritic gneiss and feldspathic gneiss. It is difficult to conceive that *these* are altered Hudson River shales. Beyond them are the primal older slates of Prof. Rogers, before referred to, then the northerly belt of serpentine, then gneiss, and occasionally (to the westward frequently) garnetiferous mica schist, then limestone, then trap, and then, fully one-quarter of a mile from the serpentine, the schistose rocks of the South Valley Hill, agreeing accurately with Mr. Hall's description of the fifth group. These intermediate beds thin out westwardly, until the serpentine, the trap and the hydromica schists of the South Valley Hill appear to come in contact.

The strike of the trap and of the southerly border of the schists, with which, in Radnor, it appears in contact, separating them from the primal older slates, being about S. 70° W., the serpentine and the schists are much closer at the western end of the Radnor Station outcrops, the intermediate strata thinning out as stated, and the serpentine perhaps crossing them in part; but even here, there is at least 800 feet of the schistose gneiss between them, with some garnetiferous mica schist, which seems to continue in a narrow belt close to the trap to near Paoli.

It will be noticed on the map accompanying Prof. Hall's paper, that this serpentine belt is made continuous from near West Chester into Delaware County in a straight line, except at the eastern end, where a marked southerly curve occurs near the line of Montgomery County, carrying the serpentine well into the rocks of group one. If my observations are correct, this line should be a series of disjointed lines, the easterly end of each more northerly than the westerly end of the succeeding; but, in

any event, if the map is correct as to the eastern extremity, the text is not so.

Mr. Hall's seventh series, page 436, is "The mica schists of Philadelphia * * * talcose schists, with soapstone and serpentine. They rest unconformably upon the first, second, third and fourth groups. * * * There are, besides these groups, probably two serpentine horizons, which are undoubtedly unconformable deposits above the second group. I think the northern belt of serpentine may be considered as altered Hudson River rock, while the southern belts are doubtful."

Page 441–442: "Dr. T. Sterry Hunt insists that the serpentines of the Schuylkill are below the Philadelphia schists. * * * At present I am inclined to place these serpentines above the Philadelphia rocks, and by so doing assign the Philadelphia series to a higher group than the Hudson River. * * * To all appearances the serpentine belts which are visible on the Schuylkill River at Lafayette Station, Montgomery County, and at a point just north of them, are above the mica schists of Philadelphia. The southern belt extends in an almost unbroken line from Chestnut Hill, Philadelphia, to Bryn Mawr, Montgomery County. A less prominent belt extends from the Schuylkill River to the neighborhood of Rosemont Station, on the Pennsylvania Railroad, in a parallel line to the first belt."

The meaning of the author in the two opinions first quoted, from pages 441–442, is not altogether clear. If there is dependence to be placed on lithological characteristics, the southern or soapstone belt continues far to the southwestward; as to it, I believe, belong the outcrops on Meadow Run, on both sides of Darby Creek, near Moro Phillips' chrome-mine, in Radnor Township; thence southwestwardly continuously through Newtown and Marple Townships. In this belt there is one rock described by me many years ago characteristic of it, and, so far as my knowledge extends, confined to it (except outcrop at Rosemont hereafter referred to) a steatite filled with crystals of serpentine pseudomorphous after staurolite. This rock is very abundant and prominent from Chestnut Hill to a point a short distance west of Mill Creek, and is found also, but not abundantly, west of Darby Creek. The northeasterly portion of this belt contains very little serpentine; steatite and chlorite constitute the greater part of its mass. Its strike is about S. 52° W., its bounding

rock is the well-known wood-like garnetiferous schist; partially altered rocks found at the soapstone quarry on the Schuylkill seem to show that it has arisen from the pseudomorphism or metamorphism of interstratified hornblendic and micaceous gneiss and schists. It contains quite a number of minerals. The northerly belt, on the contrary, is little else than a very dark, almost black serpentine; except chrysotile and asbestos, and some talc and chlorite, it is almost destitute of minerals, and at Rose's quarry has undoubtedly been formed, not from Hudson River shales, but from a hard, compact enstatitic rock visible there in place, and this rock appears to be unstratified. It extends from the Schuylkill S. 59° W. 1⅝ miles to a point on Barr's farm, where, as a hill, it suddenly ends, but it may be traced by fragments to an outcrop in the Conshohocken road, near the house of William Schalliol, and to the south of the former line of strike. Thence it crosses the road to Bryn Mawr east of a small stream, with a course about S. 35° to 40 W., and after crossing seems to curve even more southwardly, but this is on a hillside and is probably due to creep. About 400 yards beyond, in the same direction, fragments are abundant in a field. Through this portion the rock on the north appears to be a very thin bedded compact gneiss, with two, and often three, easy cleavages, together with a peculiar schistose feldspathic gneiss, in which the mica is in small masses or isolated crystals, generally with curved surfaces, remaining brilliant on exposure. On the south the rock is a schist, micaceous or chloritic, but garnets are almost and perhaps wholly absent. North of this about 250 feet, just at the crossing of two roads, is an outcrop of serpentinous rock, or a hornblendic rock partially altered to serpentine, very different from that in the southerly outcrop, and about 1400 feet S. 60° W. a similar rock appears in quantity forming a small hill. East of the Gulf road, and about S. 43° W. from the last, fragments are found in the soil. West of the Gulf road is a conspicuous bluff of serpentine dipping southwardly, and S. 45° W. an outcrop at Rosemont Station, where it has been quarried. At this point the rock resembles that of the soapstone belt, and is wholly unlike that of any other part of this, which elsewhere closely resembles that near Radnor Station.

Mr. Hall makes no mention of the Potsdam sandstone on the south side of the Chester Valley, further than in his fifth group mentioning sandy beds.

Finding, as we do, as has been described by Mr. H. C. Lewis and myself, extensive deposits along the base of the South Valley Hill, not only of a remarkably white sand, but of large masses of compact sandstone, very closely resembling that of the North Valley Hill, and the same rock, much decomposed, being found in the valley south of the South Valley Hill, accompanied by iron ore as at other places, and finding it nowhere else in the very great exposure of the hydromica schist rock of the South Valley Hill, it would seem more likely to be the Potsdam found in the same position east of the Schuylkill than mere accidental beds of sandstone, intercalated in the schists just at those points.

A trap-dyke has been referred to as lying between the hydromica schists of the South Valley Hill and the rocks on the south of it. This is prominent from the Schuylkill for about three and one-half miles to the farm of Mr. Frank Fennimore, near Wayne Station. Here it appears to widen out, and perhaps to divide into two branches, one crossing the railroad and turnpike between Wayne and Eagle, and being very prominent south and southwest of Eagle store, with a strike approximating S. 60° W. and completely within the gneiss; the other branch, or a distinct dyke, accompanying the serpentine in a more nearly due west direction. A mile southeast of Berwyn, the latter can be seen almost if not quite in contact with the serpentine, the trap, however, being on the *south* of the serpentine. The same is true south of Paoli, except that the trap appears to be on the north side. Prof. Rogers, page 168, speaks of this trap as "occurring along and outside the northern edge of the serpentine, in a succession of narrow elongated dykes, ranging more N. E. and S. W. than the serpentine." These I have not examined, but such structure agrees precisely with what I have observed of the serpentine further east.

South of the serpentine, perhaps from a bed in the Radnor gneiss, occur in the fields, often abundantly, a white quartz, weathering yellow on the surface, except certain portions which remain white. The form of many of these seems to forbid the idea of mere accident, and to suggest that they may be due to the remains of organic material which have deoxidized the contained iron, and thus facilitated its removal.

Note on Damourite from Berks Co., Penna.—Mr. F. A. Genth, Jr., remarked that a short time ago Mr. H. W. Hollenbush, of

Reading, Pa., gave him a specimen of a shaly mineral having a talcose to serpentine-like appearance, but which, when examined chemically, proved to have the composition of a damourite or mica.

It is found at Rockland Forges, Rockland Township, Berks Co., about three miles northeast from Friedensburg, and occurs as a massive pale grayish-green to light brown mineral with a more or less pearly lustre. Prof. Prime has also sent it from a locality about two and one-half miles south of Blandon; this specimen is of a pale green color with a somewhat silky lustre, H = 2 — 2.5. G = 2.85, streak white; feel smooth, sometimes slightly greasy; odor argillaceous; massive, lamellar; translucent in thin fragments.

An analysis of the Blandon specimen by Dr. Genth gave him:

Ignition,	4.86
K_2O,	9.53
Na_2O,	0.36
Fe_2O_3,	2.94
Al_2O_3,	32.11
MgO,	tr.
	99.40

An alkali determination of the specimen from Rockland Forges, gave $H_2O = 5.60$, $K_2O = 10.32$, Na_2O — 0.36, which proves the mineral to be a variety of mica or muscovite.

Associated with it is found a grayish to reddish white opaque mass of quartz, in the Rockland, and rounded grains of quartz in the Blandon specimen, the latter having a somewhat conglomerate-like appearance.

JUNE 28, 1880.

On the Stalactites of Luray Cave.—Dr. A. E. FOOTE gave a description in detail of a cavern near Luray, Va. He gave a sketch of the geology of that region and described his visit to the cavern. A number of remarkably symmetrical white and translucent stalactites were exhibited. The rapid growth of the stalactites and stalagmites, and their enormous size, were mentioned. Curled and twisted stalactites slightly resembling Flos-ferri were exhibited. It was shown that the curling and twisting was due to the fungi which, in the remarkably damp atmosphere of this cave, grew upon the surface of the stalactites and caused the water to deviate from its natural course. Over the surface of the fungus knob-like excrescences and even long lateral branches of carbonate of lime were formed.

New Localities for Gypsum.—Mr. LEWIS reported two new localities for gypsum: Smith's quarry, Easton, where it occurs in tabular crystals; and Richmond coal-field, Chesterfield Co., Va., where it occurs in crystals and in snow-white masses in triassic strata.

SEPTEMBER 27, 1880.

A New Locality for Sphene.—Dr. A. E. FOOTE described the new locality for sphene and associated minerals at Eganville, Renfrew Co., Canada. The sphene occurs in immense crystals, weighing from 20 to 80 lbs., in a vein of apatite 20 feet wide. Many other veins of smaller size occur in the same county.

The rock is principally Laurentian gneiss and granite. A solid mass of sphene, very highly cleavable ($5 \times 2 \times 2$ feet), was observed in the side of the vein. It yielded several hundred pounds of sphene. Close by it doubly-terminated crystals of scapolite, weighing over 50 lbs., and crystals of pyroxene, weighing from 12 to 30 lbs., were found. Phlogopite and zircons, some of them twinned, occur at the same locality. From the enormous size of all the crystals found in this county, it must rank as one of the most remarkable mineral localities known. When the vein, 20 feet wide, spoken of above, was discovered, a doubly-terminated crystal of apatite, weighing 500 lbs., and bright upon the surface and ends, was said to have been found.

OCTOBER 25, 1880.

A New Locality for Hyalite.—Mr. H. C. LEWIS reported that he had found hyalite forming green, glassy coatings on hornblendic gneiss at a quarry on Mill Street, Germantown. The mineral has the usual mammillary or botryoidal surface, is perfectly transparent, and has a beautiful light green color. The color is due to the presence of copper, as shown by blowpipe tests.

Note on Autunite.—Mr. H. C. LEWIS remarked that he had recently investigated the optical character of the Fairmount autunite. His examination confirmed the orthorhombic character of autunite. The bissectrix is normal to the main cleavage-plane, and parallel to the secondary diagonal planes. The optic axial divergence is 24°. The autunite from Limoges, France, has an optic axial divergence of about 38°.

DECEMBER 27, 1880.

Crystalline Cavities in Agate.—Mr. THEO. D. RAND exhibited three specimens of agate, locality unknown, in the centre of each of which was a cavity with plane sides, and casts of these cavities showing them to have been calcite crystals. The method of taking these casts, the sides of the cavities being rough with re-entering angles, was explained. A solution of glue, with about one-fifth of glycerine, of such consistence as to form a thick, firm jelly when cold, but to be perfectly fluid when hot, was prepared and heated. The specimen was then cooled to about 32°; a rough splinter of wood was inserted in the cavity which was previously moistened with cold water. A drop or two of the glue solution

—hot—was poured in and allowed to become firm. The wood was then carefully moved until the glue was detached from the stone, but not removed, or if removed the splinter marked so as to be returned to the same position. More glue was then poured in and the operation repeated. A mould was then made of the glue in plaster, and from this type-metal casts obtained.

JANUARY 24, 1881.

Note on Halotrichite.—Mr. LEWIS described two localities of halotrichite in the neighborhood of Philadelphia, and exhibited specimens. It occurs in fine incrustations on hornblendic gneiss on the river drive below Strawberry Mansion, Fairmount Park, and it occurs as an impure efflorescence at the West Jersey marl-pits, where it is mixed with sulphatite and melanterite.

On Twin Crystals of Zircon.—Dr. A. E. FOOTE recorded the discovery of perfect twin crystals of zircon, near Eganville, Renfrew Co., Canada. He had obtained small but imperfect twin crystals over four months before, but sufficiently distinct to establish the character of the twinning at that time. As in cassiterite and rutile, the twinning plane is 1 — i. It is doubtful if twins of zircon have ever been seen before.

APRIL 25, 1881.

Note on the Drift of Lycoming County, Pa.—Mr. ABRAHAM MEYER contributed some observations on the rocks and drift of Lycoming County, and especially of that portion in the vicinity of Lycoming Creek. He described the exposures on Lycoming Creek and commented on the various theories proposed to explain the geology of the county. He drew attention to the ridges of drift ("stony batter") on Lycoming Creek and on Hogelan's Run, which he supposed were formed by glacial action. He had found pebbles of granite and of hornblendic gneiss with magnetite in several places in Lycoming and Tioga Counties, and hoped that a careful study would be made of that region.

Discs of Quartz between Laminæ of Mica.—Mr. THEO. D. RAND exhibited a curious form of quartz occurring between the laminæ of muscovite, from Amelia Co., Va. Part of it was crystallized in the common form, but part was in discs, one-tenth of an inch in diameter and less, which, with polarized light under the microscope, showed a black cross which rotated as the analyzer was rotated. He stated that these disks were much like those from Swaim's quarry, Chester Co., Pa., hitherto undetermined, but much larger than the latter, and that it was probable those from Swaim's were also quartz.

On Two New Localities of Columbite.—Prof. H. CARVILL LEWIS announced two new localities for the rare mineral, Columbite. Only a single specimen of this mineral has been described from Pennsylvania. An imperfect crystal was found in Nivin's quarry, Chester County, by Mr. Tyson, and noticed by Dr. Genth in his Mineralogy of Pennsylvania (p. 137).

Attention is now drawn to a beautiful doubly-terminated crystal which was found at Mineral Hill, Delaware County, and which is now in the cabinet of W. S. Vaux, Esq. The crystal is black, with a slightly iridescent surface, and is of about seven-eighths of an inch in length and half an inch in width. The following planes are present and have been determined by a hand goniometer, viz.: the macropinakoids $i\ \bar{i}$, the brachypinakoids $i\ \breve{i}$, the prisms I, the brachydiagonal prisms $i\ \breve{3}$, the basal pinakoids O, the brachydomes, $2\ \breve{i}$, and the brachydiagonal pyramids $1\ \breve{3}$.

The second locality is the well-known Dixon's quarry, Delaware. There is a large fragment of a crystal in the collection of the Academy marked on the authority of T. Fisher as from this locality. The specimen weighs over half a pound. Its nature was determined by its physical and blowpipe characters.

The occurrence of columbite at these localities is of some geological interest in connection with the determination of the age of the formation containing it, since the associated minerals are similar to those at the columbite localities of Massachusetts and Connecticut.

On the Occurrence of Fahlunite near Philadelphia.—Prof. LEWIS stated that he had found Fahlunite at two localities in the belt of hornblendic gneiss which crosses the northern part of the city. This belt of hornblendic gneiss, especially at its exposures at Frankford and near Germantown, has already yielded many minerals of interest, but fahlunite has not hitherto been noticed in Pennsylvania.

Fahlunite occurs disseminated in irregular masses in orthoclase at McKinney's quarry, Rittenhouse Street, and at Nester & Shelmire's quarry, on Wayne Street, Germantown. Only one specimen was found at the latter place. At McKinney's quarry it occurs in small, pale green masses, somewhat after the manner of the apatite of that locality. It has a scaly structure and a felspathic cleavage. It has a hardness of about 2.5. Its color is pale apple-green, and when heated it turns dark gray. It fuses at 4.5 to a dark grayish green opaque glass. It is nearly insoluble in acids. A rough analysis, made by fusing the mineral with sodic carbonate, showed that it consisted principally of silica and alumina, while containing small quantities of iron and magnesia and traces of lime and soda. It contains 2.8 per cent. of water. Although less hydrous, it resembles the variety of fahlunite

known as chlorophyllite, and is perhaps intermediate in character between pinite and fahlunite.

All the specimens as yet collected have the aspect of pseudomorphs by alteration. Frequently there is no distinct line of demarkation between the fahlunite and the surrounding orthoclase, as though one passed into the other. At the line of junction the orthoclase sometimes becomes dull, while the fahlunite, which has its normal character in more central portions of the mass, becomes hard and resembles a greenish orthoclase. These features may be seen in the specimen presented to the Academy.

MAY 23, 1881.

On the Fossil Ores of Lycoming County.—Mr. ABRAHAM MEYER described some outcrops of fossil iron ore in Lycoming County. He stated that the ore of Larry Creek formed veins having an average width of 2 feet, but occasionally being 4 feet thick. Those veins which are inclined at a high angle (70°–80°) show slickensides on their surfaces, while the more horizontal veins have an oolitic structure. They yield 40 per cent. of metallic iron, although stated by the Geological Survey (Report F, p. 235) to contain only 16 per cent. Nodules of ore from Beatty's Run frequently contain a nucleus of carbonate of iron.

SEPTEMBER 26, 1881.

On a Mineral resembling Dopplerite from a Peat-bed at Scranton, Pa.—Prof. H. CARVILL LEWIS called attention to a very interesting substance recently found in a peat-bog at Scranton. In an excavation for the new court-house at that place, below a deposit of peat, "swamp-muck," and fallen trees, at a depth of some 25 feet from the surface, there occur veins of a black elastic substance which, when first excavated, was a stiff black jelly, but which after drying becomes brittle and nearly as hard as coal. The dried mineral resembles jet, having a brilliant lustre and a conchoidal cleavage. The peat-bog in which this substance was found is said to have been formerly a swamp or lake, which has been filled up in the extension of the town. The deposit of peat, which is covered by about 10 feet of rubbish, is over 15 feet in thickness and is said to burn well. Near the bottom of the peat, in a carbonaceous clay or "muck," the black jelly-like substance is found. It occurs in irregular veins, sometimes nearly perpendicular, throughout the lower portion of the peat, and these veins vary in thickness from a mere stain to 2½ inches. Immediately below this deposit, and underlying the whole peat-bog, is a deposit of glacial till or "hardpan." This peat-bog, therefore, like the others so numerous throughout the glaciated region, is of post-glacial age.

When the substance here described was first received, last July,

it was soft, black and elastic, having a hardness of less than one, and being almost jelly-like in consistency. After partial drying it was nearly as elastic as india-rubber. When a very thin slice was cut by a knife and examined under the microscope, it appeared brownish red by transmitted light, and was nearly homogeneous in character. It was imbedded in and surrounded by peaty matter, the latter being filled with plant remains. Occasional oval seeds are imbedded both in the peat and in the jelly-like substance. After drying for three months in the air the mineral was found to have a hardness of 2.5, and to have become brittle. The dried substance has a brilliant resinous lustre and a conchoidal fracture. It has a specific gravity of about 1.036. It is jet-black in the mass, but its powder has a dark brown color. In the closed tube it yields water and abundance of brown oil and empyreumatic vapors. The air-dried substance burns with a yellow flame while held in the flame of a Bunsen burner. In its natural elastic state it burns slowly without giving a yellow flame. It does not dissolve in ether or alcohol, but is entirely dissolved by caustic potash; and from the dark brown solution thus formed may be precipitated in reddish brown flocculent masses by the addition of acid. The filtrate from this precipitate has a pale yellow color. These are the properties of humic acid, and it is probable that this substance is an acid hydrocarbon closely related to that acid.

It is evident that this substance is the direct result of the decomposition of the surrounding peat. It may be of quite recent formation. It is of special interest in that it appears to be an intermediate product between peat and true coal, and it illustrates one method of change from the former into the latter.

In many of its characters this substance closely resembles dopplerite. Dopplerite is a black jelly-like substance, occurring in the peat-beds of Austria and Switzerland. In its method of occurrence it is precisely similar to the Scranton mineral. On exposure it hardens to a hard jet-like substance, which, however, unlike the Scranton mineral, does not burn with a flame. Dopplerite has been regarded as a truly homogeneous peat, and has been shown to have the same composition as that substance. It has never been identified in America. Whether the mineral from Scranton is to be regarded as dopplerite can only be determined after analysis. It is worthy of careful examination.

TITANIFEROUS GARNET.

BY H. A. KELLER.

At Darby, in an almost horizontal rock-stratum, I found the following very interesting occurrence of what seemed at first sight black garnets. The stratum itself is a very much weathered mica schist, 6 to 7 inches in thickness, which contains this often very much decomposed mineral as harder aggregations. The stratum is enclosed by two layers of milky quartz, each about 2 inches in thickness, to which harder less decomposed crystals of a rhombic dodecahedral shape firmly adhere. These very hard crystals are usually of a jet-black color, with vitreous, sometimes metallic lustre, passing however often into the very characteristic reddish-brown garnet substance.

The specimens I found are therefore of two kinds: 1. The very much decomposed aggregations found in the midst of the mica schist. These consist of loose granules of still unaltered garnet mixed with the separated SiO_2. They are only imperfectly held together by cohesion. 2. The hard, jet-black, sometimes partly brown crystals (∞ 0) firmly attached to the quartz lying above and below the hydromuscovite. Their hardness is 7, sp. gr. 4.25, they have no streak and are not magnetic, but possess a most remarkable cleavage parallel to the dodecahedral faces. Their composition,

SiO_2	36.92
TiO_2	1.14
FeO	27.36
Fe_2O_3	3.74
Al_2O_3	26.54
MnO	.33
CaO	2.76
MgO	1.66
	100.45

together with their appearance under the microscope, shows that there is a very intimate dissemination of a Ti Fe mineral in the garnet substance. Many of these crystals have from within become partially altered, so much so as to have often formed inside of even the hardest ones small but well-crystallized sphenes, others have changed into asbestos, mica, quartz, and even pyrite.

Their outer shape has generally by transformation become partially lost in the surrounding hydromuscovite. The Ti has probably been furnished by the two quartz strata, as I have observed, only a few feet distant, many other pieces of quartz impregnated with the same black mineral, while the enveloping strata were perfectly free from it, or had it only partly remaining as the more insoluble FeS_2.

OCTOBER 24, 1881.

Pyrophyllite and Alunogen in Coal-mines.—Mr. ELI S. REINHOLD made the following communication:

About two years ago the writer discovered in the coal slates of the North Mahanoy colliery, near Mahanoy City, Schuylkill County, an interesting mineral which, in its determination, defied the ordinary tests based on physical characters. A chemical analysis by Dr. F. A. Genth proved it to be an interesting variety of pyrophyllite. His report to the American Philosophical Society gives the results of the analysis, together with information as to occurrence, etc.

Attention is here called to that report for two reasons: First, for the purpose of making a correction; and, second, for a possible connection between pyrophyllite and the recently discovered alunogen.

When the writer furnished Dr. Genth with information regarding the pyrophyllite, he stated that it was found in but *one vein, of only one mine.* He has since found it at four different collieries, and coming from, at least, three different coal-veins.

Alunogen.—In a valley extending northeast from Mahanoy City, a distance of about a mile, are a number of collieries. A stream of water flows through it, receiving the mine-water from several of these collieries. During heavy rains the stream overflows its banks and covers a large area with the sulphur-water. The writer noticed, last spring, after the water had subsided, a white mineral coating the surface recently inundated. This mineral proves to be alunogen. In this efflorescent form it has been more abundant this summer than before.

As foreign mineralogists have noted the occurrence of this mineral in the coal-slates of Bohemia, Bavaria and England, and as the same mineral is common in our own State, as an efflorescence where iron-sulphide comes in contact with clay, its discovery here in the anthracite coal region may be regarded quite natural rather than surprising. However, there is a hint at a different origin of the alunogen found here from that ordinarily given. Instead of it being the result of the sulphur contained in the mine-water uniting with the alumina of the slate, the writer is inclined to think that the latter constituent is furnished by the

rapidly decomposing pyrophyllite, which contains fully 27 per cent. of alumina. This opinion is based on two facts:

1. Only since pyrophyllite has become abundant has this efflorescence been noticed.

2. Only at collieries where pyrophyllite is found, can traces be found of the alum deposit.

I propose to make some experiments that may throw further light on the subject; but facts, as far as observed, point to this origin of a mineral not heretofore credited to this locality. It adds one more to the extremely limited list of minerals found in the anthracite coal-field.

New Locality for Mountain Cork.—THEO. D. RAND announced a new locality for mountain cork, about one-third of a mile northwest of Radnor Station, P. R. R., Delaware Co., Pa., where it was found by him in the soil overlying the serpentine belt.

A New Locality for Aquacreptite.—Mr. G. HOWARD PARKER announced a new locality for aquacreptite. He had found it as a seam or vein in partially decomposed micaceous gneiss on Lansdowne Avenue, 1½ miles west of Hestonville, Philadelphia.

Note on Aquacreptite.—Prof. LEWIS remarked that as bearing upon the genesis of aquacreptite, it was of interest to observe that at each of the three localities where that mineral had been discovered the rock enclosing it was different from that at either of the other localities. Aquacreptite was first found at Strode's Mill, Chester County, by Mr. Jefferis, as long ago as 1832. It was known by local mineralogists under various names until described by Prof. Shepard, in 1868, as a new mineral. At this, the original locality, it occurred in serpentine. The second locality, near Marble Hall, Montgomery County, was discovered by the speaker in 1872, and is mentioned in Dr. Genth's Report on the Mineralogy of Pennsylvania. It here occurs in a pocket in limestone. At the third locality, West Philadelphia, now reported by Mr. Parker, it occurs in gneiss.

From the existence of aquacreptite in these diverse rocks, it seems probable that its origin cannot be ascribed to any direct alteration, but that, as in clays, it is in part mechanical.

Aquacreptite is a variety of bole, differing from other varieties in the greater degree of decrepitation which it undergoes when placed in water. Some time ago the speaker had made some experiments to determine the cause of this remarkable decrepitation. He had found that it was a purely mechanical action due to capillary attraction. When the porous mineral is suddenly immersed in water or any other liquid, the liquid enters its pores so rapidly as to split it open. If, however, it is gradually moistened and the enclosed air is replaced slowly by liquid, no decrepitation takes place upon subsequent immersion. That no

chemical action takes place is shown by the fact that if, after the decrepitation of the mineral, the fragments are dried, these fragments will again decrepitate when immersed in liquid, and this operation can be repeated as long as any fragments of sufficient size remain. Decrepitation takes place, whatever liquid is used, varying in degree with the mobility of the liquid employed. While very energetic in boiling water, it takes place with great slowness in sweet oil. The decrepitation of the aquacreptite of the three different localities varies also with the density of the specimens. The West Philadelphia mineral decrepitates and gives out bubbles the most rapidly, and the Chester County mineral the most slowly of the three. In some of the Chester County specimens decrepitation takes place very slowly in cold water, being most slow in the most compact specimens. The aquacreptite from Marble Hall falls to the smallest fragments. The hardness varies in different specimens from the same locality, the most variable, being however, at the Chester County locality. In general, the aquacreptite of the three localities has the following hardness, viz.: Chester-County, > 2; Marble Hall, $= 2$; W. Phila., < 2.

The emission of air-bubbles, and the phenomenon of decrepitation when immersed, may be observed in a less degree in several of the varieties of bole; and it is questionable whether a greater amount of a purely mechanical action entitles a substance of probably mechanical origin to a special mineralogical name.

Quartz Crystals from Newark, Del.—Mr. W. W. JEFFERIS stated that he had found a number of doubly-terminated quartz crystals lying loose in the soil at a new locality, near Newark, Delaware.

NOVEMBER 27, 1881.

Some Ochreous Deposits of Kentucky and Indiana.—Prof. R. B. WARDER made the following communication:

At the village of Francisville, Boone Co., Ky., a ferruginous mass crops out in the road; and a specimen of it is herewith exhibited. It consists chiefly of sand, clay and ferric hydrate, with smaller quantities of manganese and lime. A few rods north of this outcrop are many drift pebbles and some boulders; but the largest grain of sand observed in the ochreous mass was less than four millimetres in diameter. The whole bed seems to consist of rather finely pulverized siliceous drift materials, cemented with a considerable amount of iron; it resembles bog iron ore in appearance, but it probably contains too small a percentage of iron to rank as an ore, and the bed is of very limited extent.

In the neighboring parts of Indiana, very similar deposits occur at several points in Dearborn, Ohio and Switzerland Counties,

which I described in 1872.[1] These outcrops resemble that at Francisville, not only in the character of the materials, but also in their topographical situation and in the character of the neighboring soils, being found in most cases in the portions designated as "broken upland,"[2] about 300 to 400 feet above the level of the Ohio River.

The question naturally arises whether these various beds are of separate origin, or whether they are detached remnants of extensive bog deposits, stretching across the area now occupied by the river and its bottom.

The beds just described may be compared with certain masses of sand and pebbles, firmly cemented with ferric oxide, which occur in the neighborhood of Philadelphia, and are known as "Bryn Mawr gravel." These beds (as I was told by Prof. H. C. Lewis) occur on both sides of the Delaware, at an elevation of at least 400 feet above that river. The Bryn Mawr gravel, then, resembles the ochreous deposits described in this paper in the general character of the materials, the topographical situation, and the mode of occurrence; but differs in containing much coarser drift, more firmly cemented, and probably contains a less percentage of iron.

Some Philadelphia geologists regard these scattered deposits of cemented gravel as fragments of one extensive bed. Further study of the ochreous deposits described above, may yield an interesting chapter of recent geological history.

A New Mineral from Canada.—Dr. A. E. Foote called attention to some very peculiar olive-green crystals which he had noticed associated with the remarkable white garnet found by him in Hull, Province of Quebec, Canada. From the few tests he had applied he thought it might be new, and had sent the material to Mr. E. S. Dana for examination.

A Peculiar Twinned Garnet.—Mr. W. W. Jefferis exhibited a curious twinned garnet, in which the smaller crystal fitted loosely into a cavity in the larger. The smaller crystal was of lenticular shape, and could be detached from the larger one, whose dodecahedral outline it seemed to complete. He had found it at Avondale, Chester County, a locality which has furnished several hundred good crystals of garnet, from one to three inches in diameter.

[1] Geol. Survey of Ind., 1872, pp. 419, 420.
[2] Geol. Survey of Ind., 1872, pp. 389 and 423.

DECEMBER 23, 1881.

ON DIORITE.

BY ELI S. REINHOLD.

Several years ago I received a box of minerals from Placer County, California, which contained a specimen marked "Hornblende," so peculiar in appearance, that I laid it aside for special examination.

I herewith send the specimen, which proved to be diorite, a rock of volcanic origin. The arrangement of the hornblende and feldspar is different from that of any trap-rocks of same composition in the Eastern States, with which I am familiar. The centre of each nodule is composed of crystalline granules of the two minerals, hornblende and feldspar; this is enveloped by a zone of clear white feldspar, followed by another of both minerals in which the crystals are radiately arranged, at least sufficiently so to make it apparent to the unassisted eye. Another band of feldspar, less pure, however, than the first, is followed by a zone of hornblende which shades off into the coarse, crystalline, granular matrix of hornblende and feldspar of no defined arrangement.

Not having access to any lithological collection, nor even to the books descriptive of all the varieties of greenstone, I may overestimate the interest of this California rock.

A description before me of a diorite found in the Island of Corsica, known as Napoleonite, answers to many points in this specimen. The nodular masses of the Corsican greenstone are described as globular, while in the California rock they are oblate-spheroidal. It would be a matter of interest to ascertain what member of the feldspar group is represented in this rock. All my books agree in assigning the mineral in diorite (generally) to the *triclinic* feldspars; but some give labradorite, others oligoclase and albite; while another author calls it a mixture of anorthite and albite. Either the feldspar in diorite from different localities varies, or else opinions in reference to it are very diverse.

Locality is marked on specimen label.

A New Locality for Allanite.—Dr. ISAAC LEA presented a specimen of allanite and zircon, in quartz rock, which he had found at Yellow Springs, Chester County; this being a new locality for allanite.

A New Locality for Copiapite.—Mr. E. S. REINHOLD presented a specimen of copiapite which he had found at Mahanoy City. It had been identified by Prof. Lewis, and is now announced as from a new locality.

NOTES ON THE GEOLOGY OF LOWER MERION AND VICINITY.

BY THEO. D. RAND.

Of much interest to those interested in mineralogy and geology in Philadelphia is the last volume, C^6, published by the Geological Survey, covering the geology of Philadelphia County, and of the southern parts of Montgomery and Bucks, by Chas. E. Hall, with a letter of transmittal by Prof. J. P. Lesley, but I think those acquainted with this region must regret that the publication was not delayed until the adjacent parts of Delaware County were examined, and until more time could be given to the work reported on, that it might be as near perfection as possible.

Mr. Hall's conclusions are at variance with all our preconceived opinions; but that is no reason for their rejection. If his data are correct, his conclusions seem almost necessarily to follow; but it is impossible for any one familiar with the district to examine the map and text without a feeling that longer study might have modified the author's views. All will agree with him as to the difficulties to be encountered; but this should have induced the greater care. In Mr. Hall's letter he states (p. xvii), "It has been my object to locate accurately the areas of the different belts of the metamorphosed rocks." And in Prof. Lesley's letter of transmittal (q. v), "Mr. Hall has not only studied every individual exposure at least once, and the more important ones repeatedly, but has obtained from them several thousand hand specimens."

If, as a test, we examine upon the map the serpentine outcrops, which are generally so easy of identification, we shall be disappointed. For instance, tracing the steatite belt westward from the soapstone quarries on the Schuylkill, the very distinct outcrop at the corner on Hagy's Ford road, at the road crossing, one mile from the Schuylkill, is wholly omitted. The outcrop on the Black Rock road is represented as extending of a width of about 200 feet for about 900 feet eastward of the old Gulf road, $1\frac{3}{8}$ miles from the Schuylkill, while it is, at that point, over 1000 feet in breadth, and extends, though probably narrowing rapidly, fully 2000 feet eastwardly. West of this road, its location on the map is southward of its true position. This portion of the belt is made to end a short distance east of the Roberts road; whereas, on that road, it appears in place, with the garnetiferous schists

bounding it on the north, a most distinct outcrop of over a hundred feet in width. Beyond this it is not shown until the Pennsylvania Railroad, at Bryn Mawr, is reached, where a very distinct outcrop 400 feet wide and 1500 feet long is delineated, just below the bridge at Penn Avenue.

The outcrop on the Roberts road can be followed by abundant fragments in the soil to a point where the southward course of the Black Rock road changes to W. S. W., just north of which a very distinct outcrop is visible in the side of the road.

I am quite familiar with the railroad cut at Bryn Mawr, which is through decomposed mica schists. I have searched in vain for the slightest evidence of steatitic or serpentine rocks in it. Recently the cut was widened. Taking advantage of the fresh exposure, I obtained specimens below Penn Avenue about every ten feet from 150 feet to 400 feet, including a light-colored stratum differing from the bright-colored decomposing schists elsewhere. All, without exception, were unmistakably decomposed mica schist with quartz. I believe, therefore, that serpentine and steatite do not there exist at or near the surface.

Examining the more northerly belt, that north of Lafayette Station, we find it represented as ending about 2000 feet west of the Schuylkill. There is, it is true, an apparent break in the belt at this point, and, as it were, a fault, throwing the westerly continuation southward; but the break is small, and the belt can be traced by abundant surface fragments to a point between 3000 and 4000 feet from the river, where another fault occurs (or a change of direction more northwestward) and an outcrop in place appears east of a road about a mile from the Schuylkill. Thence, on the map, the outcrop appears continuous; whereas, at the next road, where there is a gap through which a stream passes, there appears to be a fault, the westerly continuation of the belt being, as it were, shifted northwardly more than its width, showing on a small, but very distinct scale, the echelon structure so marked in the belt north of the syenite. The outcrop is represented as ending east of the old Gulf or Conshohocken road; whereas it can be traced by fragments, and one outcrop in place, to the new road to Bryn Mawr at the crossing of a branch of Mill Creek, on the lands of Yocum and Shalliol, where a large distinct outcrop in place occurs, whence it can be followed by surface fragments in a more southwesterly direction (S. 35° W.), than the

easterly part of the belt, (S. 40° to 50° W.), probably 1000 feet. About 250 feet northward from this, and eastward of its ending, is another outcrop of serpentinous rock (another instance of echelon structure?). About 1400 feet S. 60° W. is another outcrop, forming a distinct small hill not upon the map, and other minor outcrops further westward. The character of rock in the outcrops adjacent, north and south, above mentioned, is different in each. The southerly is talcose and chloritic, the northerly a hornblende-like rock altered into serpentine or some allied mineral.

The outcrop at Rosemont, Pennsylvania Railroad, from which much stone has been quarried, is not upon the map.

An outcrop of serpentine is delineated northeast of the crossing of the Gulf road and the Mattson's Ford road, or Township Line road, and (p. 3) located northwest of Mechanicsville.[1]

The rock at the point indicated on the map, which is within one-eighth of a mile southeast of Gulf Mills, and over one-half mile southwest of Mechanicsville, is altered hydromica schist. It bears a remarkable resemblance to the decomposed schists in the cut of the Pennsylvania Railroad at Bryn Mawr. There are outcrops of serpentine, one in place on the Gulf road, about 500 feet S. S. E. of the cross-roads; the other, fragments in the soil, about 700 feet southeast. There is also an outcrop of similar serpentine, with steatite, on the Mattson's Ford road, just east of the Delaware County line. This is not upon the map. These outcrops, and another westward, were described in the Proceedings Acad. Nat. Sci., 1878, page 402, as belonging to a then undescribed northerly belt.

Mr. Hall (page 89) connects that on the Gulf road with the great belt passing through Radnor and through Chester County. He evidently has not examined the westerly outcrops.

The limestone in Upper Merion, just north of Gulf Mills (the south end of the Gulf), interesting in connection with that a mile farther up the Valley, is not upon the map, nor the eurite and the garnetiferous schists southeast.

Turning to the text, we find it stated (page ix) that "The ser-

[1] On the map the name Mechanicsville appears to be given to the settlement at the south end of the Gulf, correctly Gulf Mills, which name it has borne for much over a century. Gulf Mills, on the map and in the text, is applied to McFarland's Mills at the north end of the Gulf. Mechanicsville is a small town, formerly known as Rebel Hill, in a gap over one-half mile south of the Gulf.

pentine belt of Bryn Mawr, instead of passing in a straight line southwest through Delaware and Chester Counties towards Maryland, swings around southward in a curve towards Chester, on the Delaware, not in an unbroken line, but in a series of projections, like the teeth on a circular saw, some of which reach Chester Creek."

Without a map of these outcrops the precise meaning is not clear, but if a line be drawn upon the map,[1] connecting the Schuylkill soapstone quarries with the westernmost outcrop on the Black Rock road, and be produced southwestwardly to Chester Creek, the outcrop on Meadow Brook will be found three-quarters of a mile northwest of this line; that on Darby Creek, one mile northwest; that on the West Chester road, one-half mile northwest; that on the road from Newtown Square to Palmer's Mills, upon it, or very little northwest; that at Blue Hill, upon it; that on Dismal Run, thirteen miles from the Schuylkill, a quarter of a mile southeast; that at Lenni on Chester Creek, about a mile southeast.

If, in like manner, we produce a line passing through the Lafayette belt, from the Schuylkill to Rosemont, the Meadow Brook outcrop will be found upon it; that on Darby Creek, quarter of a mile northwest; West Chester road, less than a quarter of a mile southeast; Palmer's Mills, one mile southeast; Blue Hill, one mile southeast; Dismal Run, $1\frac{1}{4}$ miles southeast; Lenni, about two miles southeast.

Page 12, we find, "The primal * * * is not recognizable west of the Schuylkill river, south of the south edge of the auroral limestones of the valley in the South Valley Hill."

Page 32. "West of the Montgomery County line, near the southern margin of this group" (the South Valley Hill schists), "we find garnetiferous mica schists."

Page 36, "West of West Conshohocken the Potsdam does not exist, and the limestone rests directly upon the Laurentian;" but we find no mention of the sandstone and beds of sand, resulting from its decomposition, flanking the Chester Valley on the south, described by Prof. H. C. Lewis, in the Proceedings of the Mineralogical Section of the Acad. Nat. Sci., No. 1, page 93.

[1] I have used map of Delaware County, by G. M. Hopkins & Co., of Philadelphia, 1876, which I believe to be the most accurate map of the County.

West of West Conshohocken, a rock wholly indistinguishable from the eurite of Barren Hill, which Mr. Hall considers proved to be Potsdam, *does* occur at several (at least three) localities, viz.: southeast of Mechanicsville, in Radnor just west of the county line, and at Wayne, P. R. R.

That the limestone rests directly upon the Laurentian is more than doubtful, for while they cannot be observed between the two adjacent outcrops near the river, yet if the lines of the two be prolonged, mica schists, garnetiferous mica schists, and the peculiar thin-bedded feldspathic gneiss with crystals of hornblende found south of the syenite between the serpentine and steatite, can be seen, having a breadth of probably over three hundred feet, within a thousand westward of the limestone exposure.

There are three facts tending to prove that Cream Valley on the south side of the South Valley Hill is, though very narrow, similar in structure to the Chester Valley :

I. The presence of limestone.

II. The existence of iron ores resembling those of the Potsdam.

III. The presence of eurite.

On page 27 the Manayunk mica schists and gneisses are stated to extend from the vicinity of Haddington on the south to Ardmore on the north.

There is no mention made of the porphyritic gneiss which begins eastwardly as a narrow belt at the Falls of Schuylkill, this rock by its superior hardness causing the "falls." It widens out westwardly until at the Pennsylvania Railroad it attains a width exceeding a mile, and occupies fully one-half the limits above quoted. It extends southward to Market Street; south of this I have not examined. It is too important a belt, not only in its extent, but also in its uniformity throughout its whole limits, to be ignored in a study of the region. The same may be said of the Frankford gneiss which appears to extend as a distinct and characteristic belt, but with a strike much more east and west than the other rocks, from Frankford to the Wissahickon.

That the syenite belt south of the South Valley Hill is an anticlinal seems beyond question. Now both on the north and south of it occur thin-bedded micaceous gneiss and hornblendic gneiss, succeeded by garnetiferous mica schist. In the syenite, or very close to it in the micaceous gneiss, both on the north and south occur beds of serpentine of almost identical appearance, and in

the mica schists, steatite, talc and serpentine very similar in character on both sides of the anticlinal. So nearly vertical are all the dips that no very cogent argument can be derived from them.

North of the schists is eurite, almost undoubtedly Potsdam sandstone, then altered schists, limestone, trap, and then the South Valley Hill.

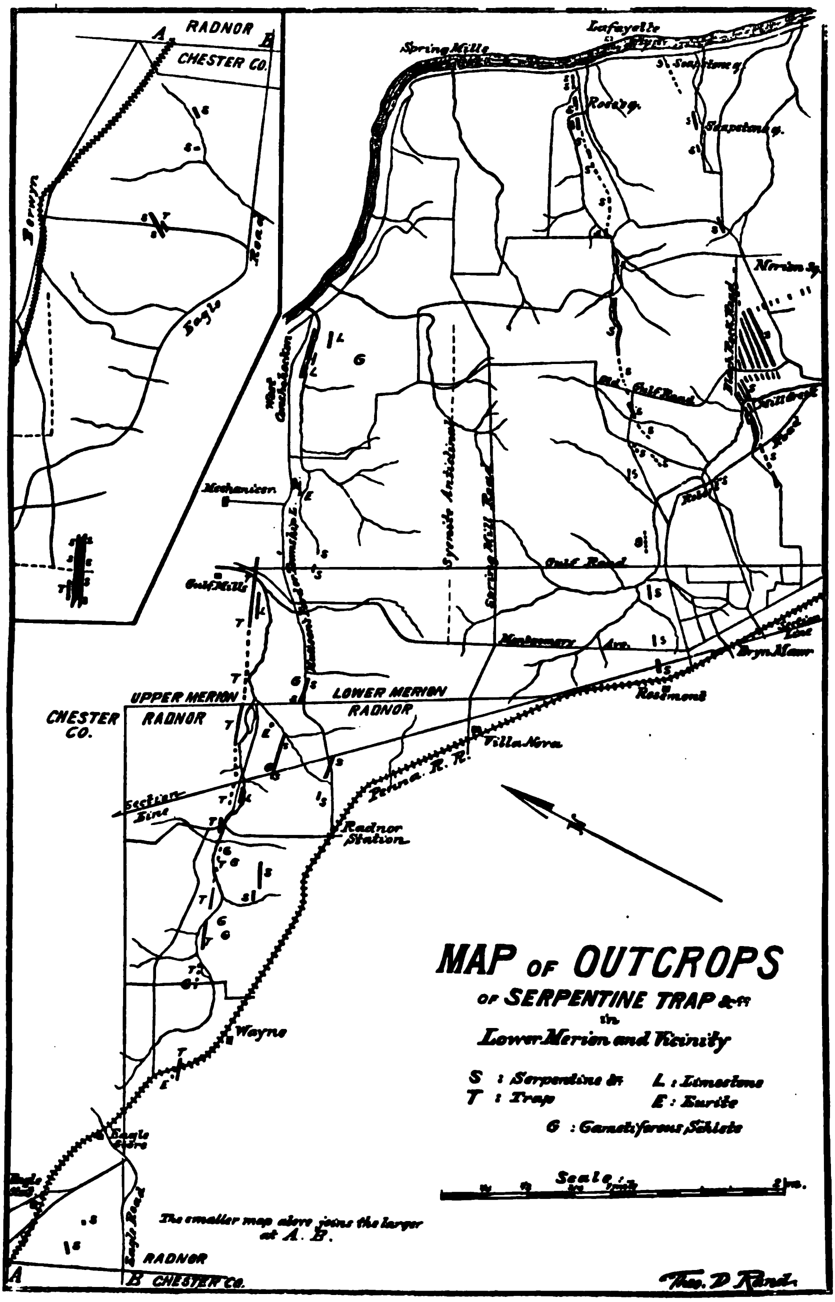
My view of a section along a line from Bryn Mawr northwest to a point in the north line of Radnor Township, Delaware County, about a half mile west of the east line, that is west of Mr. Hall's line H, and bearing a few degrees more northeast and southwest in order to connect one of the limestone outcrops in Cream Valley with the Rosemont serpentine outcrop, is given herewith. Outcrops of all the rocks are exposed within little over a half mile of this line, and all save the eurite, and the southern steatite belt, almost or quite upon it, though the characters of the rocks can in some cases be better studied in more distant outcrops, of undoubtedly identical rocks.

1. Syenite.

NORTHWARD.	SOUTHWARD.
	Thin bedded micaceous gneiss.
2. Serpentine.	2′. Serpentine.
3. { Thin-bedded gneiss. Micaceous gneiss. Feldspathic gneiss with crystals of hornblende. Hornblendic gneiss.	3′. { Mica schist and thin-bedded gneiss with crystals of hornblende. Hornblendic gneiss.
4. Steatite with serpentine.	4′. Steatite with serpentine.
5. Mica schists and garnetiferous mica schists.	5′. Garnetiferous mica schists.
Eurite.	
Schistose gneiss.	
Limestone.	
Schistose gneiss.	
Trap.	
South Valley Hill hydromica schists.	

Now if this succession occurs, if of 2 and 2′, 4 and 4′, each most closely resembles the other, and 3 and 3′, 5 and 5′, are not unlike, is it not strong evidence that the structure is a simple anticlinal?

I submit herewith a map of the region showing most of the outcrops mentioned.


MAP OF OUTCROPS
OF SERPENTINE TRAP &c.
in
Lower Merion and Vicinity
S : Serpentine &c.
L : Limestone
T : Trap
E : Eurite
G : Garnetiferous Schists
Scale
The smaller map above joins the larger at A. B.
RADNOR
CHESTER CO.
UPPER MERION
LOWER MERION
Spring Mills
Lafayette
Rosetg.
Merion Sq.
Gulf Mills
Mechanicsville
Gulf Road
Montgomery Ave.
Bryn Mawr
Rosemont
Villa Nova
Penna. R. R.
Radnor Station
Wayne
Eagle Road
Section Line
Syenite Anticlinal
Spring Mill Road
Thos. D. Rand.

On Phytocollite, a New Mineral.—Prof. LEWIS reported that, having made a further examination of the black jelly-like substance from the Scranton peat-bog, to which he had drawn attention at the September meeting, he had found that it had characters differing from those of any other mineral heretofore described. By dissolving it in a standard solution of alkali he had found that it had an acid reaction, and was, therefore, to be regarded as an organic acid. It is probably related to some of the varying forms of humic acid.

The following analysis, kindly made by Mr. J. M. Stinson, of Harrisburg, was made upon material which was carefully separated from the surrounding earthy matter, and which, before analysis, was dried at a heat of 212° F.

C	28.989		C	30.971
H	5.172		H	5.526
N	2.456	or without ash,	O + N	63.503
O	56.983			
Ash	6.400			100.
	100.			

This analysis would yield the empirical formula $C_{10}H_{12}O_{16}$.

In its composition, this substance is remarkable for the low percentage of carbon which it contains.

It differs from dopplerite principally in its composition (dopplerite having the formula $C_{12}H_{10}O_{10}$), and also by its partial solubility in alcohol and its burning with flame.

Instead, however, of giving this mineral a specific name, it is now suggested to group together, under one generic name, all those jelly-like substances produced by vegetable decomposition which are found in nature.

The name *Phytocollite* (φυτον κόλλα), signifying *plant-jelly*, would include the mineral from Scranton, the dopplerite of Austria and Switzerland, the jelly-like mineral from Finckenbach, St. Gall, which Deicke describes as burning with a bright flame, and all similar minerals of like origin. Each of the above minerals would, therefore, be classified as varieties of phytocollite.

FEBRUARY 7.

The President, Dr. LEIDY, in the chair.

Twenty-two persons present.

Filaria of the Black Bass.—Prof. LEIDY stated that he had been told that the black bass, *Micropterus nigricans*, in some localities is much infested with a red thread worm. One procured in market a few days since for his table, was found to be greatly infested. The worms were coiled in oval masses from the size of a pea to that of a large bean, and were situated beneath the skin, in the muscles and under the membrane lining the abdomen. The worm is cylindrical, slightly narrowed and obtusely rounded at both ends, minutely annulate and otherwise smooth, pale red, bright red, or brownish red, translucent, with the darker red, or brownish intestine and the white œsophagus shining through. Mouth a small pore, unarmed; anus a transverse elliptical pore, terminal. Œsophagus long, capacious, cylindrical, straight or somewhat tortuous, slightly expanded below where it is constricted from the intestine, which is likewise expanded at the commencement, and ends in a short, more translucent rectum. Ovarium and ova indistinctly seen. Length from 3 to 6 inches by half a line in diameter.

The worm appears to be a Filaria, but the determination of the species was left for more extended observation.

FEBRUARY 14.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-six persons present.

Sponges from the neighborhood of Boston.—Mr. E. POTTS exhibited some fragments of fresh-water sponges collected in the Cochituate Aqueduct and sent to him by the Superintendent of the Boston Water Works. Alluding to the deleterious effects recently attributed to this sponge, as the cause of the pollution of the Boston water-supply, he said he was not prepared either to affirm or deny it. While he was well aware that a decaying fresh-water sponge was one of the foulest things in nature, in his own experience he had never met with it in sufficient quantities, locally, to suppose it capable of tainting, in its decay, millions of gallons of water, as now represented.

An examination of the sponge as to its specific relations, revealed some peculiar facts. Primarily it was evident that the sponge was

much "mixed"; the presence of two or more species being very apparent.

One of these, with long branching finger-like processes, smooth skeleton spiculæ, no appearance of dermal or flesh spiculæ, while the abundant *smooth* statospheres retained few if any acerate spicules, bore a sufficiently close resemblance to the description of *Spongilla paupercula* as given by Dr. Bowerbank from specimens collected in the same or a neighboring locality before 1863.

With this form was found another, probably altogether sessile, consisting of an intertexture of stout fusiform accerate skeleton spicules, abruptly pointed, coarsely spined, except near the extremities, spines subconical, acute; dermal spicules absent or undiscovered; statospheres without granular coating, some of them exhibiting a few misplaced, irregular, or malformed birotulate spicules, the distinguishing feature of which is the prolongation of the familiar boss upon the outer surface of each rotule into a long acuminate spine, in line with, and a continuation of the shaft. He suggested for this species, provisionally, the name *Meyenia acuminata.*

The exceptional features referred to above, as marking this collection of sponges were: *First*, the fact that all the statospheres, whether belonging to the genus *Spongilla* or *Meyenia*, were *smooth*, that is without a granular or cellular "crust;" *second*, the apparent absence of dermal spicules in both and the abnormal character of those belonging to the statospheres. The appearance is not infrequent, but has, so far as known, heretofore been limited to the genus *Spongilla*. The recurrence of the same feature in the associated genus *Meyenia*, coupled with the fact that many of the birotulates upon its statospheres, were imperfect, the rays being more or less aborted, approximating their shape to that of the spined fusiform acerates of *Spongilla*, gave rise to the suggestion that here, possibly, had been, not merely a mechanical mixture by inter- or super-position of species, but an organic hybridization produced by the flowing together of the amœboid particles of which the sponges are composed, or even by a fertilization of the ova of one by the spermatozoids of the other.

Several facts indicative of the probability that such hybridization may take place were adduced, and the further discussion of the subject deferred until an examination of the living sponge in its native locality, or experiments upon those germinated in confinement, could be made.

It is important to notice that the specimens received were collected in February, when the sarcode matter had nearly all been washed away, with, probably, accompanying changes in the presence or numbers of the smaller spiculæ.

FEBRUARY 21.

The President, Dr. LEIDY, in the chair.

Twenty-five persons present.

The deaths of John W. Draper and Theo. Schwann, correspondents, were announced.

The death of Robert Bridges, M. D., having been announced, Dr. W. S. W. Ruschenberger was appointed to prepare a biographical notice for publication in the Proceedings.

FEBRUARY 28.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

On Tourmalines.—Prof. LEIDY said, in absence of other matters of more importance, he would exhibit a collection of tourmalines which belonged to him, and which he thought from their variety would interest the members. He remarked that while black tourmalines are the most common, white ones are rarest. Recently, good-sized crystals of the latter had been found at De Kalb, St. Lawrence Co., New York. From a broken crystal he had obtained a fragment, from which the beautiful gem presented was cut. This is of brilliant form, highly lustrous, transparent, flawless, and nearly colorless, or with only the faintest yellowish tint, like that of a so-called "off-color" diamond; and weighs 398 millegrammes. Some remarkable black tourmalines were brought to this city, a couple of years ago, by Lieut. Wm. A. Mintzer, U. S. N., who obtained them at Niantilik, Cumberland Gulf, Arctic America. They are generally three- or six-sided crystals, with a single three- or six-sided pyramidal termination, of various sizes. A large one in Prof. Leidy's possession is thirteen inches long and one and three-quarter inches at the pyramidal extremity. Perhaps the most beautiful black tourmalines, recently discovered in abundance, are those of Pierrepont, St. Lawrence Co., N. Y. They are remarkable for their perfection; occurring as doubly-terminated crystals, of large size and brilliant lustre. Fine brown tourmalines, often of large size and frequently doubly terminated, with one extremity much modified from the usual form, have also been found in abundance in late years, at Gouverneur, St. Lawrence Co., N. Y. It may be said that this State is pre-eminent for the beauty of its black, white, and brown tourmalines.

The chief localities for colored tourmalines, other than the varieties mentioned, are the Urals, Ceylon, Elba, Brazil and Maine. Of the collection, those from the latter two localities most resemble one another; crystals of the same ordinary tourmaline green color, others of a green color and garnet red-axis, and some with different parts of the prism colored pink and green, of varied depth. The pink is sometimes as delicate as that usual in Elba tourmalines, and sometimes as deep and bright as that of the deepest-hued pink topazes of Brazil. The Maine tourmalines exhibit a wonderful variety of shades of green and red, ranging from the darkest hues to the transparent colorless variety called achroite. The largest and finest achroites seen by Prof. Leidy, have been derived from the Mt. Mica locality.

Among the Maine tourmalines in the collection, chiefly obtained through Dr. A. C. Hamlin, of Bangor, the following were especially indicated:

1. A three-sided prismatic crystal with one end flat, the other a trilateral pyramid, four inches long, and ten lines wide. One half towards the pyramidal end is green, dark and nearly opaque at first, but becoming transparent apple-green; the other half is green on the exterior, but has a garnet-red axis towards the flat end, passing into pale pink towards the middle of the crystal. The specimen is broken into five fragments, a condition quite common in the larger Maine tourmalines, and supposed to be due to the action of frosts. 2. Two fragments of a crystal, an inch and a half in diameter, of a bright, rose-topaz color, becoming nearly colorless and then ending in an apple-green plate, forming a flat termination of the crystal. 3. A fragment of a three-sided crystal, an inch long and an inch and a half wide, consisting of transparent achroite, with one end covered with Cookeite. 4. A dark green three-sided crystal with trilateral pyramid, an inch and a quarter long, and three-fourths of an inch in diameter. The base was occupied with a spherical nodule of achroite, from which was cut a beautiful gem, of brilliant form, flawless, perfectly transparent, and weighing 400 millegrammes. It is nearly colorless, but has a faint pinkish hue.

Among the Brazilian tourmalines were the following:

1. A large, three-sided crystal, with pyramidal termination, rich tourmaline-green, transparent and flawless. It was originally two inches and a half long, and is eight lines wide. From its base a fine brilliant was cut, weighing 5980 millegrammes. 2. Two small green crystals with pyramidal termination, one pale red at the terminal end; the other of the same color at the base. 3. Two large six-sided crystals with flat termination, green externally, with garnet-red axis. One an inch and a half long, and three-fourths of an inch thick; the other an inch and a quarter long, and an inch thick. 4. A rubellite of garnet-red color; a three-sided crystal with pyramidal termination, an inch long, and seven-eighths broad.

Brilliant cut specimens of rose-red tourmaline from Maine and Brazil were alike in color. An Elba tourmaline about an inch in length was six-sided with a three-sided pyramid. The base is yellowish green; the upper extremity pale pink. A Ural rubellite, garnet-red, was six-sided with a six-sided pyramid.

Frank E. P. Lynde was elected a member.

Robert Hartmann, of Berlin; W. Kowalewsky, of Moscow, and K. Martin, of Leiden, were elected correspondents.

The following was ordered to be printed:—

THE SPECIES OF ODONTOMYIA FOUND IN THE UNITED STATES.

BY DR. L. T. DAY.

In this paper I have confined myself exclusively to the description of the species found in the United States.

O. limbipennis Macq. I have left out entirely, for the following reason: on page 255 of Baron Osten Sacken's valuable catalogue of N. A. Diptera, note 57, he says: "The label in Macquart's handwriting in Mr. Bigot's collection bears *America*, with a query; the query is omitted in the Dipt. Exot. I doubt that this is a North American species." Of the Canadian species *O.* (*Stratiomys*) *canadensis* Walk., and *O. inequalis* Loew, Hudson Bay Ter., only the latter has been identified; probably the former never will be. Of the Mexican species none have been identified. Of the Cuban, *O. rufipes* and *O. scalaris* Loew are marked as being identified. Olivier, in the Encycl. Method, viii, gives the following generic characters, which I insert in the original, as they may be of service to some:

Antennes à peine de la longueur de la tête, filiformes, termineès en pointe; articles courts, presqu'égaux.

Trompe courte; gaine recourbée sendue et renflée a son extremité.

Trois soies inégales; lévre supérieure courte, échancrée.

Antennules courtes, biarticulées, en masse.

Ailes avec une cellule centrale, petite, polygone.

In the following table I have included only those species which are new, and those identified in my collection. Those species of Loew not in the table, and of Say, Walker, Wiedemann and Olivier, I have inserted at the end of the descriptions represented in the table.

Synopsis of Species.

	Head black, ...	A.
	Head with yellow or green markings, ...	F.
A.	Dorsum of thorax pubescent, ...	B.
	Dorsum of thorax pilose, ...	C.
B.	Face with an eminence below the base of the antennæ,	*nigra*, sp. n.
	Face gently arched without eminence. .	*plebeja* Loew.

C. Face of male small, ... *flava* sp. n.
Face of male of usual size, ... D.
D. Femora black, ... *pilosus* sp. n.
Femora not black, ... E.
E. Second joint of antennæ shorter than the first, *pubescens*, sp. n.
Second joint as long or longer than first, *americana*, sp. n.
F. Dorsum of thorax with lateral stripes, ... H.
Dorsum with spots on the posterior angles, . . G.
G. Color markings luteous, ... *microstoma* Loew.
Color markings greenish, ... *bicolor* sp. n.
H. Face with distinct black spots, . . . *Willistoni* sp. n.
Face without black spots, ... I.
I. Dorsum of thorax with two spots on the suture, *megacephala* Loew.
Dorsum of thorax without spots on the suture, *extremis* sp. n.

Odontomyia nigra sp. n. ♀.

Black. Head black. Occipital disk black. Front shining black, in the central groove a stripe of a golden hue. Antennæ ferruginous red, the first two joints of nearly equal size, the third longer than both and tipped with brown or black. Face prominent, black, and sparsely pubescent with golden pile; a well-defined eminence is situated beneath the antennæ. Oral aperture small, proboscis black, so also labii and palpi. Thorax black, covered with golden pubescence. Scutellum concolorous, also clothed with the pile, the terminal bristles brownish yellow. Halteres green. Abdomen dark yellow; the median stripe black and forms a triangular spot in each segment, the base anterior. Venter brownish yellow. Legs luteous. Wings hyaline; third longitudinal vein simple; the discal cell emits two veins.

Long. corp. 4 lin., long. al. 3 lin.

Hab.—Kansas (E. W. Guild).

NOTE.—In one of the specimens the abdomen is black, with a feeble attempt at markings near the incisures by way of golden pile; the antennæ are black, and the terminal joints of the middle and posterior tarsi.

Odontomyia plebeja Loew. ♂ ♀.

♂. Black; the whole head concolorous; face not prominent, gently arched and clothed with golden yellow pile. Antennæ reddish at the base, the terminal joint being black. Thorax black

and clothed with golden yellow pubescence. Scutellum concolorous, the apical spines yellowish. Halteres green. Abdomen green, with a black irregular stripe, extending almost to the posterior margin of the fifth segment. Venter green, immaculate; legs wholly yellow. Wings hyaline, the veins yellow, the third longitudinal simple, the discal cell emits two veins.

♀. Front black with irregular spots of subaureous tomentose. Face and thorax clothed with subaureous tomentose in place of the golden yellow pile in the male.

Long. corp. 3½ lin., long. al. 3 lin.

Hab.—Kansas (Guild); Mass. (Williston); Conn. (Norton).

Odontomyia flava sp. n. ♂

Black; head concolorous, antennæ black. Face small, black, clothed with yellowish pile; borders of the mouth slightly reddish. Thorax black, clothed with golden pile. Scutellum black, the terminal spines concolorous. Halteres yellow. Abdomen yellow, with black median stripe, the yellow running in at the incisures, thus forming connected quadrangular black spots in the segments. Venter yellow, immaculate; legs yellowish; femora brown; tarsi black; anterior and middle tibiæ with a solitary brownish ring. Wings hyaline, veins yellow, third longitudinal simple, the discal cell emits three veins, the posterior being rudimentary.

Long. corp. 5½ lin., long. al. 4 lin.

Hab.—Wyoming (Dr. Williston).

NOTE.—This is described from a single specimen, and the rudimentary vein emitted from the discal cell may not hold as a good character for distinguishing species.

Odontomyia pilosus sp. n. ♂

Black. The whole head concolorous. Antennæ black. The face prominent and thickly clothed with long yellowish pile. Thorax and scutellum black and also thickly clothed with the long yellowish pile, the terminal spines of the scutellum yellow. Halteres yellow. Abdomen black, and sparsely clothed with the yellowish pile, laterally are triangular yellow spots running in transversely at the incisures. Venter yellow, with small brown spots in the median line, situated in the middle of each segment. Legs blackish; femora black, the under side covered with a thick growth of yellow hair; the distal half of all the tibiæ black, the proximal portion being yellow; tips of tarsi black. Wings hya-

line, the veins reddish brown, third longitudinal simple, the discal cell emits two veins.

Long. corp. 6 lin., long. al. 4½ lin.

Hab.—California (Baron).

Odontomyia pubescens sp. n. ♂ ♀

♀. Black. The whole head concolorous. Front sparsely golden pubescent. Antennæ black, the first joint longer than the second. Face prominent and covered with golden pubescence. Proboscis black. Thorax black, with golden pubescence. Scutellum black, also pubescent, the apical spines yellow. Halteres green. Abdomen black, with lateral transverse yellow stripes at the incisures. Venter yellow with irregular brownish spots. Legs brownish yellow. Wings hyaline, veins brownish yellow, third longitudinal vein simple, the discal cell emits two veins.

Long. corp. 4½ lin., long. al. 4 lin.

Hab.—New York (Dr. Williston).

♂. Black. The face covered with a thick yellowish pile, as also the thorax; the apical spines of the scutellum yellow. Halteres yellow. The yellow spots at the incisures of the abdomen more prominent than in the female. Legs yellowish brown, femora tipped with black.

Hab.—California (Baron); New York.

NOTE. - In one of the male specimens the halteres are green, in another from the same locality yellow. I do not consider the change of color of any value; in the living specimens they were probably green.

Odontomyia americana sp. n. ♂.

Black. Head black. Antennæ reddish brown, the second joint as long or longer than the first. Face small, not prominent. Proboscis black. Thorax black and covered with a yellowish white pubescence. Scutellum the same, the apical spines being yellow. Halteres green. Abdomen green, with a median black stripe of nearly equal breadth throughout. Venter green, immaculate. Legs yellow. Wings hyaline, veins yellow, the third longitudinal simple, the discoidal cell emitting two veins.

Long. corp. 4 lin., long. al. 3 lin.

Hab.—Cal. (Baron).

Odontomyia microstoma Loew. ♀.

Black-yellow. Head yellow; occiput yellow. Front widens slightly anteriorly, about the centre or on either side is situated a

brownish spot, anterior to this it is clear, posterior sparsely mottled; ocellar triangle black, and on each side is a brownish spot. Antennæ brownish black; the first two joints cylindrical, brownish; the terminal end of the second darker; the third black, tapering to a point. Face not prominent, moderately convex and clothed with dilute yellow pile. Oral aperture small; proboscis black; labii brownish; palpi yellow.

Dorsum of thorax black, subaureous pubescent, posterior angles yellowish. Scutellum yellow, the apical spines tipped with black. Abdomen brownish yellow, the central black stripe is interrupted by median yellowish spots. Venter dilutely yellow, laterally with two dark stripes. Legs dark yellow; posterior tarsi obscurely brown. Wings hyaline, veins yellowish, third longitudinal simple; the discoidal cell emits two veins.

Long. corp. 5 lin., long. al. 4 lin.

Hab.—Mass., N. Y. (Dr. Williston).

NOTE.—"The last two segments of the third joint of the antennæ in this species form a sufficiently acute style, as may be shown; the antennæ of this are not dissimilar to those of *Clitellaria*, but the downward course of the veins in this species demonstrates its place in the Odontomyiæ."—LOEW.

Odontomyia bicolor sp. n. ♂.

Black-green. Head large, yellowish green. Occiput yellowish green. Antennæ reddish brown, the terminal segment of the third joint tipped with black. Face prominent, green, sparsely pubescent with yellow. Proboscis brownish black. Thorax black, the posterior angles yellow, the lateral borders clothed with yellow pile. Pleuræ green and clothed with yellow pile. Base of scutellum black, bordered with yellow; the apical spines yellow, tipped with black. Halteres green. Abdomen green, with a median black irregular stripe. Venter green, immaculate. Legs reddish, the femora being yellowish towards the body, the tarsi black. Wings hyaline, veins brownish, the third longitudinal simple; the discal cell emits three veins.

Long. corp. 6 lin., long. al. $4\frac{1}{2}$ lin.

Hab—Cal. (Baron).

Odontomyia Willistoni sp. n. ♀.

Green. Head and occiput green. Front broad, green, with two brownish spots on each side near the orbit, also a central brown spot just anterior to the ocellar triangle. Antennæ black. Face greenish, prominent, with an irregular black spot on each

side extending from the base of the antennæ downward. Proboscis black. Thorax black, sparsely pubescent, bordered laterally with yellowish green, extending to the posterior angles. Pleuræ yellowish green, with a central narrow black stripe extending to beneath the halteres. Scutellum green, apical spines yellowish. Halteres green. Abdomen green, with a central black irregular stripe, which terminates in the middle of the last segment. Legs yellowish, concolorous. Wings hyaline, veins yellow, the third longitudinal simple; the discal cell emits three veins.

Long. corp. 4 lin.. long. al. 3 lin.

Hab.—New York (Dr. Williston).

The above species is respectfully dedicated to Dr. S. W. Williston, to whom I am greatly indebted for the use of his extensive collections in the preparation of this paper.

Odontomyia megacephala Loew. ♂ ♀

♂. Black-green. Head and occiput yellowish green; the head very large. Antennæ reddish, the terminal joint being almost black. Face yellowish green, immaculate, not prominent, receding towards the oral aperture. Proboscis black. Thorax black, pubescent with yellow, the lateral borders and posterior angles green; there is also a greenish spot on each side of the thorax near the median line crossing the transverse suture. Pleuræ green, clothed with yellowish pile. Scutellum yellowish green; the apical spines yellow, tipped with black. Halteres green. Abdomen green, with a black median stripe; the posterior half of the terminal segment green. Venter wholly green. Legs reddish; the anterior and middle tibiæ markedly tipped with black, the posterior obscurely so; all the tarsi tipped with black. Wings hyaline; veins yellow; third longitudinal simple; the discoidal cell emits three valid veins.

Long. corp. 5½ lin.; long. al. 4 lin.

♀. Green. Head and occiput green. Front green, widening anteriorly with two well-marked transverse black stripes, the superior being the broader, extending from orbit to orbit just beneath the ocellar triangle; the lower extends irregularly transverse across the whole front a short distance above the base of the antennæ. Antennæ reddish brown, the third joint tipped with black.

Long. corp. 7 lin., long. al. 5 lin.

Hab.—Kansas (Guild); Cal. (Baron).

Odontomyia extremis sp. n. ♀ ♂

♀. Green-black. Head and occiput green. Front green; on each side, midway between the ocellar triangle and the base of the antennæ, is a large round black spot. Antennæ brownish; the terminal segments of the third joint black. Face green, prominent, pubescent with yellow. Thorax black, subaureous tomentose, bordered laterally with green, extending to the posterior angles. Scutellum green; the apical spines yellow. Halteres green. Abdomen green, with a central black stripe widening posteriorly; at the incisures the black extends quite to the lateral borders. Legs brownish yellow; tarsi blackish. Wings hyaline; veins yellow; the third longitudinal simple; the discal cell emits three veins.

♂. The only difference from the females is that the males possess a black occiput.

Long corp. 6 lin., long. al. 4½ lin.

Hab.—Conn.; Cal. (Baron).

NOTE.—Related to *O. cincta*, but differing in the abdominal markings quite strongly.

Odontomyia arcuata Loew. ♀ Cent. x, 4.

Greenish yellow; occiput except orbit, vertex, unequal band of the front, base of antennæ, dorsum of thorax and abdomen black; lateral spots in the median line of the abdomen almost united, and venter wholly yellow. Legs luteous; two submarginal cells; four posterior.

Long. corp. 5½ lin., long. al. 4¼–4⅓ lin.

Head pale yellow. Face obtuse, immaculate. Occiput, except the orbit, black. Superior third of the front black; in posterior margin two obsolete luteous dots; in front the unequal black band is seen, composed of two large spots running into the sides. Antennæ black; base reddish brown. Dorsum of thorax, except the humeri and posterior angles, black, aureous tomentose, toward the borders thickly clothed. Scutellum yellow; base black; apical teeth small, subapproximate, toward the apex black. Pleuræ wholly immaculate, greenish yellow, in life without doubt green. Abdomen black; second, third and fourth segments each with a single yellow triangular spot; or greenish yellow, concave anteriorly, and the acute angle extending nearly to the middle of the abdomen; posterior and lateral margins of the fifth segment yellow, yet the transverse smearing black and more pronounced; sixth segment yellow. Venter wholly yellowish green or green,

immaculate. Legs luteous; tarsi, from the apex of the first joint, brownish black. Wings pure hyaline; veins strongly ochreous; third longitudinal with branch; discal cell emits two veins.

Hab.—California (H. Edwards).

Odontomyia binotata Loew. ♂ Cent. vi. 22.

Green. Dorsum of the thorax, except the lateral borders and two disks, punctate; metanotum and abdominal stripes black; only one submarginal cell, five posterior.

Long. corp. $5\frac{1}{2}$ lin , long. al. $4\frac{1}{2}$ lin.

Vertical triangle black; base green; frontal triangle minute, black. First two joints of the antennæ cylindrical, subequal, of ferruginous red. Face totally green, not prominent, toward the oral aperture strongly receding. Keel moderately convex and obtuse. Proboscis pale; palpi concolorous, labelli black. Dorsum of thorax black; two small spots and lateral borders green. Pleuræ green; breast grayish black. Scutellum totally green; metanotum black. Abdomen green; the stripe towards the base of the first segment strongly dilated, in the second and third segments profoundly emarginated, and the two points in the angle of the fourth segment black. Venter wholly green. Legs ferruginous red; the first half of the femora and base of the tibiæ yellow; the apex of the anterior femora, the apex of the anterior tibiæ and all the tarsi black, but the posterior metatarsus except the apex and base of the anterior, ferruginous red. Wings purely hyaline; veins strongly ochreous; third longitudinal without branch; the discal cell emits three equal veins.

Hab.—Illinois (Le Baron).

Odontomyia lasiophthalma Loew. ♂. Cent. vi, 23.

Black, varied green, eyes strongly pilose, second joint of the antennæ half as short as the first. Legs luteous, femora except the apex black, one submarginal cell of the wings, five posterior.

Long. corp. $4\frac{1}{6}$ lin., long. al. $3\frac{1}{3}$ lin.

Head black; face concolorous, shortly conical, two transverse spots constituting narrowly interrupted bands, and two lesser at the anterior margin of the eye pale yellow. Eyes clothed with compact long hair. First two joints of the antennæ dark yellow, toward the apex obscure, the second one-half, and the last longer than the first; the third joint is wanting in this specimen. Dorsum of thorax with rough sub-luteous black hair, posterior angle yellowish green. Pleuræ concolorous, whitish hair, two spots of

a yellowish green, the larger ones of a broken angular form, the smaller oblong ovate. Scutellum black, narrowly bordered with yellowish green. Abdomen black, the whole margin and spots both a third part green, in the second segment a spot large and triangular, not reaching to the anterior margin: the third moderate and transverse, the fourth narrow. Venter wholly green. Legs luteous or luteo-ochreous, femora except the apex black. Wings hyaline, veins thickly ochreous, third longitudinal without a branch, the discal cell emits three equal veins.

Hab.—New York; New Jersey.

NOTE.—This species on account of the first joint of the antennæ being longer than the second strongly distinguishes between Stratiomyiæ and Odontomyiæ, and as it were intermediate on account of the simple straight third longitudinal vein refers this genus to the Odontomyia rather than Stratiomyiæ.

Odontom·ia n gerrima Loew. ♀ Cent. x, 6.

Black, bare, scutellum toothed, apex of femora and tibiæ, and base of tibiæ and tarsi testaceous; second abdominal segment, third and fourth posterior margins near the border and all of the fifth lutescent; face protuberant, extraordinarily prominent, first joint of the antennæ longer than the second, veins of the wings strongly fuscous, four posterior cells and two submarginal.

Long. corp. 4 lin., long. al. 3½ lin.

Black, shining, bare, whitish, short pubescent. Head concolorous, longitudinal fossa of the front and both margins testaceous. Face extraordinarily prominent, protuberant, obtuse, lateral margins of the mouth strongly dilated. Proboscis black, stock drawn out, head long and very thick. Antennæ drawn out, black, first joint once and a-half as long as the second. Scutellum wholly black, teeth fusco-testaceous. Posterior margins of the second abdominal segment, third and fourth toward the side of the abdomen of a lutescent color, thus three narrow bands are seen, broadly interrupted; the posterior margin of the fifth segment wholly lutescent. Venter black, a broad disk unequal and darkly lutescent. This abdominal picture in living specimens I suspect to be wholly green. Legs black, apex of the femora, base and apex of the tibiæ and first and last joints of the tarsi except the apex fusco-luteo-testaceous. Wings hyaline, veins strongly brownish black, costal and third longitudinal subfuscous toward the apex, third longitudinal vein with erect branch, discoidal cell emits two veins.

Middle States.

Odontomyia nigrirostris Loew. ♂. Cent. vi, 19.

Black and yellow varied, scutellum without teeth, two submarginal cells, five posterior.

Long. corp. 5⅗ lin., long. al. 4¾ lin.

Black and yellow varied, clothed with pale pubescence. Head yellow; lateral frontal stripes black, broad, abbreviated anteriorly, posteriorly with a black spot cohering with the vertex; a large black spot on the face. Antennæ black, first joint a little longer than the second. Proboscis wholly black, palpi concolorous. Dorsum of thorax black, margin of the posterior angles pale yellow. Pleuræ pale yellow, black maculated; breast black. Scutellum shortened, pale yellow, toward the base black. Abdomen broad, subplanum, black, from the angle of the first segment, a spot extends laterally from the anterior to the posterior margins, narrow in the third and fourth margins posteriorly and in the abdominal margin, all pale yellow. Venter wholly pale. Legs black, apex of all the femora, first half of anterior tibiæ and base of anterior and posterior tarsi dilute yellow or whitish. Wings pure hyaline, veins strongly ochreous, third longitudinal with branch, thus is made two marginal cells; discal cell emits three veins of which the one preceding the last is much shorter.

Hab.—North Wisconsin (Kennicot).

NOTE.—The number of posterior cells in distinguishing *Odontomyia* causes note, which is greatly relied upon; less is determined by making out the number of submarginal cells, in those species where there is only one submarginal cell, which does not happen rarely, as the third vein may be with a branch; or where two submarginal cells are found, this branch may be wanting.

Odontomyia pilimana Loew. ♂ ♀ Cent. vi, 27.

Black, antennæ red, dorsum of thorax in both sexes aureous tomentose, abdomen green, median stripe black, legs luteous, anterior and posterior tibiæ and metatarsus hairy beneath; four posterior cells, one submarginal.

♂. Thoracic pile shorter than in known species.

♀. Front near the ocelli luteous bipunctate.

Long. corp. 4–$4\frac{7}{12}$ lin., long. al. $3\frac{1}{12}$–$3\frac{5}{12}$ lin.

♂. Head black, face scattered with white hair, obtuse bicarinate, below the antennæ prominent, toward the oral aperture receding. Antennæ red, apex of third joint black. Proboscis thick, black. Thorax wholly black; dorsum more lutescent, thin in real male species and clothed with short aureous tomentose; pleuræ white

pilose. Scutellum black, teeth and apical margin greenish. Abdomen green, black median stripe, moderately dilated posteriorly. Legs wholly luteous; anterior and posterior tibiæ and metatarsus clothed beneath with long pallid pile. Wings hyaline, veins strongly lutescent, third longitudinal with branch, discal cell emits two veins.

♀. Similar to the male. Front anterior to ocelli luteous bipunctate, and on both sides ornamented with an aureous tomentose spot. Above posterior to the orbit aureous tomentose; below covered with white. Dorsum of thorax closely aureous tomentose, pleuræ white pilose. Black abdominal stripe in third and fourth segments more dilated than in the male.

Hab.—Illinois (L. Baron).

Odontomyia varipes Loew. ♂. Cent. vi, 21

Green, dorsum of thorax except the posterior angles, triangular spot at the base of the scutellum, and except the large lateral spots of the abdomen and border of the fifth segment black. Legs brownish, first half of the femora and base of tibiæ yellow, apical half of tibiæ and tarsi brownish black; two submarginal cells, five posterior.

Long. corp. $5\frac{1}{3}$ lin., long. al. $3\frac{5}{8}$ lin.

Related to *Odontomyia megacephala*, but the head is smaller and diverse other markings on the abdomen. Vertical triangle black, yet the base green; frontal triangle minute black. First two joints of the antennæ cylindrical, equal; the first brownish black; the second ferruginous red; the third joint in this described specimen is wanting. Face green, superior margin black, not prominent; towards the oral aperture strongly receding, obtuse carinate. Proboscis dilute yellow, palpi concolorous, labelli black. Dorsum of thorax black, posterior angles green. Scutellum green, black spot of the base broadly triangular. Pleuræ green, a moderately dilute subfuscous spot. Abdomen black, angle of the first segment, a large lateral spot in the second and third, extending to the anterior and posterior margins, separated from the anterior margin by a black band, a lesser subrotund spot in the fourth segment, and the posterior and lateral borders of the fifth segment green. Venter wholly green. Femora dilute yellow, second half of anterior, last third of middle, and apex of posterior ferruginous red; tibiæ ferruginous red; apical half of anterior, apex of posterior, brownish black; tarsi brownish black;

first joint of posterior, except the apex, reddish, and base of the lowest anterior, brown. Wings pure hyaline, valid veins obscurely ochreous, third longitudinal with branch; the discal cell emits three equal veins.

Hab.—Carolina.

Odontomyia vertebrata Say.

♂. Mouth deep, black, pale within; hypostoma with an elevated testaceous knob; antennæ deep black, terminal joint beneath dusky, testaceous; thorax blackish, with hardly perceptible hairs; scutellum dull testaceous, black at base; tip a little hairy; spines horizontal, white; wings white; poisers white, with a whitish glaucous capitulum; feet yellowish white; abdomen subquadrate, much depressed, white; tergum with a series of large black spots almost connected together.

Length ♂ rather more than three-tenths of an inch.

Hab.—Northwest Territory.

Say, Complete Writ. i, 251; Long's Exped., App., 369. Wied. Auss. Zw. ii, 73, 20. Bellardi, Saggio, etc., i, 38.

Odontomyia Paron Walker. ♂ ♀.

♂. Body black; head as broad as the chest, clothed in front with short whitish hairs, red about the feelers; eyes reddish bronze; facets of the fore-part larger than those elsewhere; mouth black; feelers black, red at the base; chest and breast thickly clothed with tawny hairs; scutcheon armed with two tawny teeth; sides and under side of abdomen tawny, sometimes yellow and tinged with green; legs tawny; wings whitish; wing-ribs tawny; veins yellow; poisers tawny, with apple-green knobs.

♀. Head and chest bronzed; head black about the base of the feelers.

Length of body 3 lin., long. al. 6 lin.

Hab.—Trenton Falls.

Walker. Li-t iii, 536.

Odontomyia intermedia Wied. ♀.

Fühler schwarz, erstes Glied nur halb so lang als das dritte. Untergesicht schwarz, fast silberweisz behaart. Stirn mitten rostgelblich, an beiden Seiten schwarz, mit zwei fast silberschimmernden Flucken; am Scheitel erstreckt sich das Gelbe bis zu den Augen. Rückenschild schwarz, sehr kurz kiesgelb behaart; Brustseiten hingegen silberweisz behaart; Rand und Darmen des Schildchens gelblische. Hinterleib kaum weiszlich behaart; an

der Spitze der Abschnitte 2–4 an jeden Seite ein linienartiger rostgelblischer Fleck oder eine breit unterbrochene Binde; der Hinterrand des fünften Abschnittes überall lehmgelblich und mit dem Gelblichen des Seitenrandes zusammenfliesend. Bauch gelblich. Flügel wasserklar; Rippe und die zweite Ader bis zur Spitze des Rippenfeldes lehmgelblich; das Randmal und die mittlere Zelle umgebenden Adern rein braun; Schwingen schön grün. Beine lehmgelblich; Schenkel fast bis zur Spitze pechschwarz. In meiner Sammlung.

Länge 3½ Linien. Aus Nordamerika.

Wied. Auss. Zw. ii, 64, 5.

Odontomyia Virgo Wied. ♂.

Der europäischen *Str. viridula* äuszert ähnlich. Fühlerwurzel rostgelb, das dritte Glied ist verloren gegangen. Kopf schwarz. Untergesicht schneeweisz behaart. Rückenschild schwarz, mit greiser Behaarung; Brustseiten schwarz, schneeweisz behaart; Dornen des Schildchens lehmgelb. Hinterleib papageigrün, mit breiter schwarzer, an der Spitze jedes Abschnittes wenig verengerter, an der Wurzel des letzten Abschnittes abgebrochener Strieme. Bauch grün, an der Spitze jedes Abschnittes ein bräunlicher nicht scharf begräntzter Fleck. Flügel sehr wasserklar, mit lehmgelb Adern; Schwinger lehmgelb mit grünem Knopfe. Beine überall lehmgelb. In meiner Sammlung.

Länge 4 Linien. Von Savannah.

Weid. Auss. Zw. ii, 69, 13.

Odontomyia brevipennis Oliv.

Odontomyia scutello subbidentato nigra, abdomine maculis lateralibus flavis acutis.

Elle ressemble aux précédentes. Les antennes sont noires avec les deux premiers articles jaunes. La tête et le corcelet sont noirâtres, couverts d'un léger duvet d'un gris un peu rousseâtre.

L'écusson est noir, et armé de deux petites épines rapprochées, à peine apparentes, jaunes. L'abdomen est noirâtre en dessus, avec une suite de petites taches jaunes sur les côtés, triangulaires, avec leur angle interne trèsaigu. Le dessous est d'un jaune un peu livide. Les cuisses sont noirs, avec l'extrémité jaune. Les jambes et les tarses sont jaunes. Les ailes sont transparentes, avec les nervures légérement jaunes; elles sont courtes, et dépassent à peine l'abdomen.

Elle se trouve dans la Carolina, d'où elle a été appartíe par M. Bose.

Encycl. Method, viii, 434, 13.

Odontomyia cincta Oliv.

O. scutello bidentato, viridis, thoracis dorso nigra, abdomine nigro, fasciis tribus interruptis, flavis.

Elle est presqu'aussi grande que l'odontomyie fourchue. Les antennes sont jaunâtres. Le tête est verte ou jaunâtre, avec trois points noirs sur le vertex. Le dos du corcelet est noirâtre. Les côtés et l'écusson sont verts ou jaunâtres; celui-ci est armé de deux petites épines. L'abdomen est noir en dessus, avec trois bandes interrompues et un peu amincies au milieu, d'un jaune plus ou moins vert. Le dessous du corps est jaune ou vert. Les pattes sont jaunes. Les ailes sont transparentes, avec les nervures jaunes.

Elle se trouve en Carolina; Illinois.

Encycl. Method, viii, 432, 3. .Macquart, Dipt. Exot. i., 2, 189.

Odontomyia flavicornis Oliv.

O. scutello bidentato, nigra, capite scutelloque flavis, abdomine maculis lateralibus argenteis.

Ella a un peu plus de trois lignes de longueur. Les antennes sont jaunes, avec l'extrémité noire. La tête est jaune, avec les yeux noirs. Le corcelat est noir, avec quelques raies formées par un duvet argenté. L'écusson est grand, jaune, armé de deux fortes épines de la même couleur. L'abdomen est large, court, un peu aplati, noir, avec quatre taches de chaque côté, formées par un duvet argenté. Les pattes sont noires, avec les genoux et le premier article des tarses blanchâtres. Les ailes sont transparentes. avec les nervures d'un jaunne-brun. Les balanciers sont jaunes.

Elle se trouve dans l'Amerique septentrionale.

Encycl. Method, viii, 433, 9. Macquart, Hist. Nat. Dipt., i, 248, 4.

Odontomyia hieroglyphica Oliv.

O. scutello mutico viridi, abdomine nigra, maculis lateralibus viridibus.

Elle est de la grandeur de l'odontomyie hydroléon. Les antennes sont noires. La tête est verte, marquée d'une tache noire, assez grande, à la partie antérieure; de deux autres un peu au dessus, sinueuses, et d'une triangulaire, anterieurement dentée, sur le vertex. Le corcelet est noirâtre avec le côtés et l'écusson verts; celui-ci est mutique ou armé de deux épines à peine appar-

entes. L'abdomen est noir, avec trois petites taches verdâtres sur les côtes, et une sur l'anus. Le dessous du corps est vert ou d'une vert-jaune. Les cuisses sont noires, avec l'extrémité jaune. Les jambes et les tarses sont jaunes, tachés de noir. Les ailes ont une légère teinte d'un brun-rousseatre, surtout vers le bord extérieur.

Carolina and Dist. Columbia.

Encycl. Method, viii, 434, 11.

Odontomyia interrupta Oliv.

O. scutello bidentato, nigra, abdomine fasciis tribus interruptis, anoque flavis.

Elle est de la grandeur de l'odontomyie tigrine. Les antennes sont noires. La tête est noire avec une petite tache oblongue, jaune sur le vertex. Le corcelet est noir, couvert d'un léger duvet court, argenté. L'écusson est de la même couleur, et est armé de deux petites épines jaunes. L'abdomen est noir, avec trois petites taches sur les côtés, d'une égale épaisseur, et une sur l'anus, d'un jaune-verdâtre. Les pattes sont jaunes, avec les cuisses presqu'éntiérement noires. En dessous la poitrine est noire, et l'abdomen est verdâtre. Les ailes sont transparentes, avec les nervures d'un brun-rousseâtre.

Carolina.

Encycl. Method, viii, 433, 8.

Odontomyia obscura Oliv.

O. scutello flavo mutico, nigra, capite flavo punctato.

Elle est de la grandeur de l'odontomyie tigrine. Les antennes sont noires, avec la base d'un jaune-obscur. La tête est noire, avec quelques points et le bord postérieur jaunes. Le corcelet est noir, couvert d'un léger duvet d'un gris-rousseâtre. L'écusson est jaune, sans épines, ou voit seulment quelques cils qui tiennent lieu d'épines. La poitrine est noire avec un peu de jaune sur les côtés. L'abdomen est noir, avec quelques taches triangulaires peu apparentes sur les côtés, formées par un léger duvet argenté. Le dessous est noir, avec tache verte à la base. Les cuisses sont noires, avec les genoux jaunes. Les jambes et les tarses sont jaunes. Les ailes sont transparentes, avec les nervures légérement jaunes.

Carolina.

Encycl. Method, viii. 433, 7. Macquart, Dipt. Exot., i, 2, 189.

March 7, 1882.

The President, Dr. Leidy, in the chair.

Thirty-five persons present.

The death of Joseph Pancoast, M. D., was announced.

The Relation of Heat to the Sexes of Flowers.—Mr. Thomas Meehan observed that the best fields for biological research were to be found amongst objects with which we have already a more or less familiar acquaintance. One fact observed will prove a stepping-stone to higher knowledge. His first new discoveries in *Acer dasycarpum*, the common silver maple of our streets, were communicated to the Academy and published in the Proceedings for 1868, and there had been interesting observations made on this species in the line of those discoveries on many occasions since that time. In that paper it was noted that the tree was not polygamous, as stated in the text-books, but strictly monœcious or diœcious. There were no hermaphrodite flowers, but each tree was either male or female, though occasionally the separate sexes were found on the same tree. The male flowers have no trace of a gynœcium, but the female flowers have well-formed anthers, but never have pollen, or even perfect themselves by lengthening filaments, as in the perfect male flower. Notwithstanding the perfect form of the anther, the stamens in the female are abortive. But the chief physiological fact of importance noted in the paper of 1868, was that a tree which for years would produce nothing but female flowers would sometimes change the sex, and bear only male flowers; while no instance could be found of a male tree eventually producing female-bearing branches. During the fourteen years since this discovery was recorded, Mr. Meehan said he had found frequent instances of change from female to male as at first observed, but not one instance of change from male to female. There could be no doubt of the order in which the sexual change occurred. While the maple was growing vigorously it followed the rule with all trees and made no attempt to flower. With some check to the vegetative force, the reproductive power asserted itself, and flowering began; this is the second stage. With a greater check to the vegetative force, only male flowers resulted. This was the third stage. Since that time he had shown to the Academy that when a maple-tree passed from the vegetative to the reproductive condition, and bore at once male flowers only, it was a leap down from the first to the third stage, missing the second or female—for he had found that though the amount of vital power exerted in the production of seeds, and the immense loss of leaves which the production of seed implied (as

all know who are familiar with the silver maple after bearing a heavy crop of seeds), the female trees of the same age and under the same circumstances, were usually as large as the males which had no such strain on their nutritive powers.

He desired the members to pause here a few minutes, while he called their attention to another matter which he had recently brought to the notice of the Academy. It was in relation to the influence of heat on flower-buds. About the time of the fall of the leaf, there is little to distinguish a flower-bud from a leaf-bud. But the flower-bud continues to grow at a comparatively low temperature at which the leaf-bud remains stationary. Even when the thermometer was several degrees below the freezing point, flower-buds would increase in size, though naturally much more rapidly when above this line. In the peach, the growth of the flower-bud was very rapid between 32° and 40° Fahr., until by early spring they will have reached often as much as three-fourths larger in size. Indeed, a peach-bud will often have its flowers fully expanded before the leaf-bud has scarcely begun to grow. We learn from this lesson that it takes less heat to develop a flower-bud than a leaf-bud. In the light of these observations, he had been watching during the past winter the behavior of the buds on the silver maple. These advanced gradually until, by February 23, they commenced to expand—the leaf-buds remaining as they were at the fall of the leaf. They had been expanding continually as the days were warmer or colder, up to the present date (March 7), but the expanding blossoms have been wholly male flowers. Only to-day, as noted in the specimens exhibited, were the purple tips of the pistils visible through the parting bud-scales. It was obvious that here we had reached another important stage in the life history of the maple-tree. First, it requires less heat to induce growth in a maple flower-bud than a leaf-bud; secondly, it requires less heat to induce growth in the male flower than in the female.

Comparing the male with the female trees, Mr. Meehan noted differences in their habits of growth. Taking a twig of the last season's growth, in a flowering condition, one or two blossoms might appear alongside of the leaf-bud, in trees of either sex. So far we could find no difference. But in the female tree the central or leaf-bud, when it pushed into growth in the spring, made a shoot of several or many inches in length according to the vigor of the tree or parent branch. In the male tree, on the contrary, the central growth was not more than perhaps a quarter of an inch, forming a mere tuft of leaves on the top of what was a head of male flowers. In fact these branches were reduced to mere spurs, and weak spurs at that. He had measured these little branches or spurs which had been bearing male flowers for ten successive years, which were not more than from three to five inches in length, and not thicker than wheat straws. It was from these spurs that the great mass of opened flowers appeared. The male

flowers on the shoots of last year did not advance as did the flowers on the spurs. It is very important to note this fact. These are only now opening, and are cotemporaneous with the opening of the female flowers which, like them, are sparsely arranged around the axillary bud of the past season. The immense amount of pollen from the early flowers, forming the great bulk of all the pollen produced by the tree, is scattered before the female flowers open, and is absolutely useless for any purpose of fertilization, or useless for any purpose of individual benefit to the tree or to the race, so far as we can see. These later-opening flowers, formed on the wood of last year, are evidently the chief reliance, if not the only reliance, of the female flower for its reproductive energy.

Just here an objection may be raised. If it be heat alone which advances the male flowers on the spurs, why does it not advance them on the wood of last year? If it take less heat to bring forward a male flower than a female flower, why is not this power exhibited when the separate flowers happen to be on branches both apparently alike in vital conditions? Here we may return to the point we diverged from. We have seen that there are successive stages from a high vegetative, but unproductive condition, to one of fertility; and again one lower than this, lower in comparison with vegetative power, in which the purely male or sterile condition is reached. In other words, a highly vital condition is more closely allied with those attributes which characterize the female sex than with those characteristic of the male, and we may therefore reasonably look for some influence in the female direction on the male flower where these conditions exist. Therefore male flowers on a shoot characterized by a highly vitalized condition, would be likely to resist influences to which they would be otherwise subjected. In short a male flower on a strong branch ought not to yield as readily to the excitement of heat as one growing on a weak branch. At any rate the fact that the whole of the weak spurs of the maple-tree produce nothing but male flowers, and that these male flowers expand at a lower temperature than the females do, is conclusive as to the law, whatever answer the objection may receive.

This law, thus demonstrated, will be of great practical value to culturists. So far as the single point of the advancement of the flowers by a low temperature is concerned, the peach-grower will be interested in keeping the temperature cool so that there shall be no advance of the flower until the temperature is high enough to bring forth the leaf-buds as well. Now we can go further and understand why some amentaceous plants so often produce no fruit or imperfect seeds. It is well known that isolated trees of birch, though producing abundance of male and female flowers, very often have not a perfect seed. We may now see how the catkins may be brought forward by a low temperature not sufficient to excite the female flowers, and thus lead them to mature

and shed their pollen before the weather is warm enough to bring forward the female blossom to receive the necessary pollination. In seasons where the weather is cool till the regular springtime comes, or in climates where there is little very exciting warmth till the regular growing time arrives, there is not likely to be so great a period between the opening of the male and the female flowers. That this is the case with the common European hazel or filbert as grown in this country, an examination to-day clearly indicates. The catkins have attained their full length, and the anthers are ready to shed their pollen with another day's sun, but there is no sign yet of the little purple stigmas bursting through the scales of the buds which form the female flowers. Should the anthers disperse their pollen to-morrow, as they doubtless will if the temperature rises to 45°, there certainly can be no fertilization, and consequently no hazel-nuts from the trees in question next year. It was a well-known fact that the European hazel-nut often failed to bear nuts in this part of Pennsylvania, and we have clearly the explanation in the facts now developed. In Europe there were seldom such failures, the climate being probably favorable, more favorable to the simultaneous production of male and female flowers.

Mr. Meehan then briefly referred to the influence which these new facts must have on questions of dichogamy. There need not necessarily be any constant rule in the production of proterandrous or proterogynous flowers. We might expect to find proterandry prevailing to a greater extent in plants growing where there was a more constant succession of warm and cool days, than in the same species growing where the climate is not what is called changeable, that is to say, where the temperature was regularly low until the regular spring season had arrived, in which case there would not be much difference in time between the advance of stamens or pistils.

In conclusion he said, if he might be allowed to generalize from this experience with the maple-tree, the following principles seem proven:—

Male flowers do not appear on female maple-trees till some of its vital power has become exhausted.

Branch-buds bearing female flowers, have vital power sufficient to develop into branches.

Branch-buds bearing male flowers, have not vital power enough to develop into branches, but remain as spurs, which ever after produce male flowers only.

Buds producing male flowers only, are more excited by heat than females, and expand at a low temperature under which the females remain quiescent.

A few warm days, succeeded by cooler ones, will therefore make a corresponding difference in time between the opening of the male and the female flowers, and possibly in the proportionate advancement of the stamens and pistils in hermaphrodite flowers.

Professor HEILPRIN remarked that in the south of France there were often warm days in winter, much as we have here, but he believed there were no failures in the hazel-nut there.

Mr. Meehan said that when he used the word Europe, he had England in his mind, as his own personal experience was chiefly drawn from there. In that country, he believed, the catkins were never brought on by warm days in winter, so as to mature before there was warmth enough to develop the female flowers.

The President, Dr. JOSEPH LEIDY, inquired whether the American species (*Corylus Americana*) exhibited the same characteristics as the English species?

Mr. Meehan replied that he believed it would be found to do so, in some degree.

On Balanoglossus, etc.—Prof. LEIDY stated that in a recent trip to Atlantic City, he had observed the singular worm, *Balanoglossus aurantiacus*. It occurs in moderate number along the shore of a pond between the beach and the lighthouse. In the same position he had collected *Solen ensis*, specimens of which were presented this evening. As this occurred in considerable number, he had procured a sufficient quantity to try it as an article of food, and had found it to make excellent soup. In the vicinity he had picked up a number of specimens of *Actinia rapiformis*, which had been recently thrown upon the beach. On a former occasion, at Atlantic City, he had observed another Actinia, the *Bicidium parasiticum*, which is parasitic on the large jelly-fish, *Cyanea arctica*, so frequently thrown on shore during the summer.

Scolithus in Gravel.—Prof. LEIDY remarked, that since making the communication on some rock specimens, he had been led to suppose that if the quartzite pebbles of our gravels were largely derived from the Potsdam sandstone, the characteristic fossil, *Scolithus*, would be found as an occasional associate. With this view he had recently taken an opportunity of examining a gravel bank on the University ground, and had there picked up the three specimens exhibited, with well-marked *Scolithus*, which were broken from as many boulders. He also directed attention to specimens presented by Mr. John Ford. These consist of pebbles of a chalky white porous siliceous rock, with impressions of brachipod shells, which were picked up from the gravel of the reservoir at Fairmount Park.

MARCH 14.

The President, Dr. LEIDY, in the chair.

Twenty-three persons present.

The death of Geo. B. Dixon and that of James Lanman Harmer, members, were announced.

On the Occurrence of Ammonites in Deposits of Tertiary Age.—Professor ANGELO HEILPRIN stated that he desired to place on record the discovery of the remains of ammonites in deposits of tertiary age. Hitherto the members of this group of cephalopod mollusks were considered to have become extinct with the cretaceous (mesozoic) period, no form having thus far been found either in Europe or America, or in any other country whose geology had been worked up, that could with positiveness be stated to have transgressed the limits of this period. The specimen particularly referred to (now in the possession of the Academy) was found imbedded in a rock fragment belonging to the so-called Tejon group of Fort Tejon, California, a series of rock deposits considered by the late Mr. Gabb and Prof. Whitney, of the California Survey, to represent the uppermost member of the cretaceous deposits of that State. Mr. Heilprin stated that, having recently had occasion to carefully study the fossil organisms contained in the Tejon rocks, and the types of the collection (deposited in the Academy Museum) which form the basis of Gabb's important work on the palæontology of California, he had arrived at the conclusion that these so-called cretaceous deposits were unquestionably tertiary, a view which had likewise been maintained for some time by the late Mr. Conrad, but which, in the absence of positive evidence, appears to have been subsequently abandoned. Mr. Heilprin further remarked that, with the exception of one solitary fragment of an ammonite, there was, to his knowledge, not a single distinctively cretaceous type of organism to be found in all the rock fragments, but, on the contrary, several genera, distinctively tertiary, and not known anywhere to have appeared before that period, were characteristic of these fragments. Furthermore, these last contained a few species undistinguishable from forms found in the tertiary deposits of the eastern United States. In answer to certain remarks made by Dr. HORN, as to the stratigraphical position occupied by the rocks whence the specimens were obtained, Prof. Heilprin stated that he was aware that the deposits in question had been described as lying conformably with the cretaceous, but that stratigraphical position by itself was no criterion for determining the geological age of a horizon, the only true test being the facies of the contained organic remains. The discovery of ammonitic remains in tertiary strata need not especially surprise the geologist, since recently Prof. Waagen, of Vienna, had announced their discovery in the carboniferous of India, two degrees lower in the geological scale than the deposits they had up to that time been supposed to characterize.

MARCH 21.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-seven persons present.

On the Condylarthra.—Professor COPE made some observations on the characters of the newly-discovered group of Perissodactyle ungulates, which he had called the *Condylarthra*. He defined it as follows, comparing it with the typical *Perissodactyla*, which he referred to a suborder, under the name *Diplarthra:*

Astragalus with one uniformly convex distal articular face; humerus with epicondylar foramen. *Condylarthra.*

Astragalus with two truncate or concave distal articular facets for the cuboid and navicular bones; no epicondylar foramen of humerus. *Diplarthra.*

The *Condylarthra* have as yet been only found in lowest horizon of the Eocene period, the Puerco and Wasatch, and only on the North American Continent. Appropriately to this position in time, its structure indicates that it is the most primitive type of the order of the *Perissodactyla*. A number of genera and species belong to it, and these fall into two families, which are defined as below. They conform to the definitions of the order, in possessing an alternating arrangement of the carpal bones, and a third trochanter of the femur. The approximation to the *Hyracoidea* is greater than that of any group of the *Perissodactyla*. That order agrees with the *Condylarthra* in the simple articular extremity of the astragalus, which is, however, less convex; but it has a very peculiar articulation with the anterior face of the distal extremity of the fibula, seen in no other group of ungulates. In the manus the lunar bone is very peculiar, not being divided below into two facets as in other ungulates, and articulating with the carpals of the trapezoides series (the intercalare) as well as with the unciform. In these points the *Condylarthra* agree with other *Perissodactyla*. In *Hyrax* there is also no epicondylar foramen. The two families are defined as follows:

Dentition bunodont; toes 5–5; premolar teeth different from the molars above and below. *Phenacodontidæ.*

Dentition lophodont, with crescents and deep valleys; premolars partly like molars below; toes ? *Meniscotheriidæ.*

The bunodont dentition and five toes on all the feet, give the *Phenacodontidæ* the lowest place in the suborder and order, as the most generalized type known. The *Meniscotheriidæ* have a quite specialized dentition, and until I learned its condylarthrous character, I was at a loss to account for the presence of such perfection in so old a type. The number of the toes is yet unknown, but I suspect from the large size of those I have seen, that they

are less numerous than in the *Phenacodontidæ*. It appears to have had no descendants, and is a good illustration of Dr. Kowalewsky's views as to the persistence of the "adaptive" over the "non-adaptive" types of articulation. Kowalewsky observed that the type of Ungulata which have the carpo-metacarpal, and tarso-metatarsal articulations, simple and not alternating, have become extinct. In those which persisted, the metapodials articulate with two bones of the carpal or tarsal series. The same rule has generally applied in the Ungulates to the distal astragalar articulation. The *Diplarthra* and *Amblypoda*, with the double articulation, have left descendants, while the *Condylarthra*, with the single articulation, have disappeared without leaving a trace. The *Proboscidea*, which have the same simple distal articulation, still remain, however, to show an exception to this generalization.

The *Condylarthra* are distributed as follows:

	Puerco.	Wasatch.
PHENACODONTIDÆ.		
Anacodon,		1
Phenacodus,	2	8
Protogonia.	1	
Pantolambda,	1	
Catathlæus,	3	
Anisonchus,	1	
Haploconus,	3	
Periptychus,	1	
MENISCOTHERIIDÆ.		
Meniscotherium,	3	
	15	9

The genera of *Phenacodontidæ* are distinguished as follows:

I. Fourth superior and inferior premolars with an internal cusp.
   Last superior premolars with two external cusps; inferior molars with well-developed cusps. *Phenacodus*.
   Inferior molars with flat grinding faces; no cusps. *Anacodon*.
   Last superior premolar with but one external cusp; inferior molars with *V*s. *Protogonia*.
   Inferior premolars consisting of an anterior *V* and a posterior longitudinal crest. *Pantolambda*.

II. Fourth superior premolar with a high internal cingulum concentric with the single external cusp.
   a. Superior molars with intermediate tubercles; fourth premolars with internal cusps.
   Posterior inner tubercles of the superior molars not cut off; several superior premolars with internal cingulum. *Catathlæus*.
   aa. Superior molars with intermediate tubercles forming branches of a *V* with the anterior inner; posterior inner distinct and cut off by a groove; inferior premolars without inner cusps; first inferior true molar tubercular.
   Third superior premolar with elevated internal crest. *Anisonchus*.
   Third superior premolar a cone without inner crest. *Haploconus*.
   aaa. Superior molars unknown; inferior true molars with anterior lobe; the first with a transverse heel instead of opposite tubercles.
   Anterior external lobe of inferior molars forming a cutting edge. *Periptychus*.

The only genus of the above, in which the structure of the feet is well known, is *Phenacodus*. It is partially known in *Catathlæus*.

The only genus of *Meniscotheriidæ* is distinguished as follows:

Inferior premolars consisting of two *Vs*. *Meniscotherium*.

Variation in the Nest Forms of the Furrow Spider, Epeira strix.—Rev. Dr. H. C. McCook remarked that he had observed that some of the orbweaving spiders had a marked tendency to vary the forms of their nests. The spinning work of spiders may be classified as (1), the *snare*, spun for the capture of prey; (2), the *enswathment*, by which insects are disarmed and prepared for food; (3), the *gossamer*, used for purposes of aqueous or aerial locomotion; (4), the *cocoon*, spun for the propagation and protection of the species; and (5), the *nest*, which is a domicile more or less elaborate and permanent, within or under which the aranead dwells for protection against enemies and weather changes. As a rule, the great groups of Orbweavers differ from each other and agree within themselves in the characteristic form of nest. The form prevailing in each family is substantially the same; each species appears to adhere quite steadily to one characteristic form; but there are some marked variations in the habit of certain species, the most decided of which have been observed in the case of *Epeira strix*. Some examples of this were given.

1. The ordinary nest of Strix when domiciled in the open field or wood, is a rolled leaf. A single leaf is taken, the edge pulled up, drawn under and fastened by adhesive threads into a rude cylinder, within which the spider hides during the day-time. A thread connection with the foundation lines of the snare is maintained; but rarely with the centre of the orb by a taut trap-line as is the habit of the Insular spider, *Epeira insularis*.

2. A second form of nest varies from the rolled leaf nest, in having the edges of two adjacent leaves bent towards each other and lashed together on the exterior at the juncture by silken cords, and on the interior by adhesive tissue-web. An oval opening is left at the united points of the leaves, through which the connecting line passes to the snare. The spider domiciles within the leafy cavern thus formed.

3. Again, the spider avails herself of small holes in wood or stone, openings in fences, the interspace between curled bark on the trunk of old trees, or some like cavity, which she appropriates as a nesting-place. A slight lining will generally be found upon the concave surface. Dr. McCook had noticed that in such cases the snare is sometimes diverted from its normal shape in order to give a covenient approach thereto from the den. One such example was found spun between a side of the Peace Fountain in Fairmount Park (Philadelphia) and the stone wall adjoining.

In order to pitch her tent within a hole in the rock, the spider diverted one of the radii from the plane of the orb and extended it backward to the hole. The spirals which passed over this radius thus made an elbow or angle, which was indeed nearly a right angle, and gave the orb an odd, broken appearance. The radius, of course, served as the bridge-line by which Strix passed from her den to her snare.

4. Another variation was due to an accident in the environment of the web. A half-grown Strix had woven a snare in the hollow of a decayed tree (at New Lisbon, Ohio), within two feet of the ground. A colony of the Pennsylvania carpenter ant (*Camponotus Pennsylvanicus*) had quarters in the tree, a squad of black workers were busy excavating their wooden galleries. These dumped their chippings from openings just above the spider's orb, whose viscid spirals retained goodly quantities of the brown saw-dust. In course of time a ball of chippings as big as a walnut had accumulated, or, perhaps had been purposely massed by the spider. However that may be, the ball was utilized as a nest; its centre had been pierced, a spherical cavity formed by silk-lining the interior, which was entered by a circular door bound around the edge by spinning-work. This quaint domicile was pendant from one of the strong upper foundation lines, and herein Strix rested, while the emmet carpenters worked away above her, continually dropped chips upon the roof of her den, and the orb beneath, until one side of the snare was quite covered with them. In this case the position of the nest, as well as its form was exceptional, as the nest site of Strix is well nigh invariably beyond the limits of the web, sometimes, indeed, several feet. In these points the spider was evidently led to an intelligent variation of her nest-building by circumstances.

5. Another variation, or rather a series of variations, was noted upon the side of Brush Mountain at Bellwood, Pennsylvania. Several young pine-trees had been cut away and tossed from the mountain to the banks of the Juniata River below. The foliage had withered and fallen from the boughs, whose branches stretched out dry and bare, and among them a colony of young furrow spiders had pitched their tents and spread their snares. One specimen happened to spin her web near the axil of several goodly sized branches, which were formed into a natural shelter by the inverted position of the bough. The spider had recognized this vantage, and made her nest at the point of juncture, or rather took shelter there, for there was very little artificial nesting beyond a faint tissue spread over the bark at the point where she sat.

A second specimen had lodged at a point near the tip of a small branch whose delicate dry twigs gave no sufficient shelter, and besides, were directed upward. Accordingly a silken tube, funnel-shaped, was spun between the twigs, within which young Strix nested.

A third spider lodged in a similar site, had made a silken sack for a tent, whose mouth had apparently originally opened directly toward the snare. But a saltigrade spider had fastened a parasitic tubular nest upon one side of this sack, and accordingly the mouth was found closed and the door shifted to the opposite side, as though to avoid interference with a troublesome neighbor.

A fourth individual had woven a simple silken cover or screen, behind which she lodged. A fifth had pitched her tent upon a stray leaf beneath which a similar cover, a small rectangular piece of silk canvas (suggestive of the military bivouac or "dog tent") was stretched by lines attached to the sides and corners, and fastened to the leaf surfaces and surroundings. Between this sheet and the leaf the spider was ensconced having the usual bridge-line connection with the orb.

6. Two of the above colony had established nests in tufts of a parasitic moss fastened upon the dead limbs. One of these was very pretty and ingenious. The moss grew in a bunch about the size of a hickory-nut; this was pierced at the top, and the filaments pushed aside sufficiently to allow an interior cavity large enough to house a spider. An oval door or opening was formed near the top by bending and binding back the fibres of the plant. A secure and tasteful retreat was thus obtained at the only really available spot in the vicinity of the snare.

7. When the furrow spider weaves her orb upon the exposed surfaces of human habitations, as the cornices of porches, outhouses, etc., her nest takes a form quite different from any of the above. A tube of stiff silken fibre is spun against the surface to which it is lashed at all sides. This cylinder is about an inch long and half-an-inch thick, and at the end toward the orb has a circular opening about a quarter of an inch in diameter. The stiff texture of the nest appears to be necessary to make the walls self-supporting, inasmuch as there are no supports like the twigs and leaves found at hand in arboreal sites. Moreover, the open position of the domicile exposes the spider very freely to the assaults of the mud-daubers who frequent such localities, to birds and other enemies, so that a canvas is needed of tougher texture than that required in sheltered sites. It may be remarked that in old buildings, which present cracks and crannies convenient for nesting, woven nests of this sort will rarely be found.

It is thus seen that while there is a general regard to protection of the spider's person, there is a modification over a quite wide degree of variation in the form of the protective nest. Further, that this modification appears to be regulated more or less, by the accidental environment of the domicile, and in such wise as to show no small degree of intelligence in adapting the ordinary spinning habit to various circumstances, and to economizing labor and material.

MARCH 28.

The President, Dr. LEIDY, in the chair.

Forty-one persons present.

The death of R. S. Kenderdine, M. D., and that of Solomon W. Roberts, members, were announced.

Mr. Isaac C. Martindale offered the following, which was adopted and ordered to be printed:—

This Academy having learned with deep regret of the death of its worthy member and curator, Robert S. Kenderdine, M. D., and desiring to place upon record the regret we feel in thus having to part with his valued services as an officer and his agreeable company as a member, a regret increased by our recollection of the geniality and open-heartedness which always characterized his association with us, therefore

Resolved, That realizing the loss which has been sustained, we tender to his family our sincere sympathy in this hour of affliction.

Resolved, That a copy of these resolutions, signed by the President and Recording Secretary, be forwarded to his family and that they be entered in full upon the minutes and published in the Proceedings.

Art. XIV, Chap. V, of the By-Laws, was amended by striking out all of the article after the word "meetings" in the third line, and inserting "and with like approval may change the same."

Geo. Taylor Robinson, M. D., Eugene M. Aaron, and John Edgar were elected members.

An American Locality for Helvite.—Prof. H. CARVILL LEWIS remarked that among some minerals which he had recently obtained from the mica mine near Amelia Court House, Virginia, a locality already well-known for its microlite and other rare minerals, was a yellow crystalline substance, which upon examination had proved to be *Helvite*. The mineral occurs in crystals and friable crystalline masses imbedded in bluish white orthoclase, and is generally associated with pale red topazolite. While no crystals were found sufficiently perfect to allow of measurement, the absence of any action upon polarized light proved their isometric character.

The mineral has a hardness of about 6, a specific gravity of 4.306, a sulphur-yellow color, a somewhat resinous lustre, and is partially translucent. It fuses at about 4 with intumescence to a

brown glass, gives no water in the closed tube, and with the fluxes gives the reactions for manganese. Fused on charcoal with soda, it gives a hepar. It is soluble in hydrochloric acid, evolving sulphuretted hydrogen and leaving a residue of gelatinous silica.

Its composition, as kindly ascertained by Mr. Reuben Haines, is as follows:

SiO_2	23.10
BeO	11.47
MnO	45.38
Fe_2O_3	2.05
Al_2O_3	2.68
CaO	.64
K_2O	.89
Na_2O	.92
S	4.50
Gangue	9.22
	100.35

In the analysis the glucina and manganese were first separated from alumina and iron by long boiling with ammonium chloride, and were then separated from each other by repeated precipitation by ammonia, the manganese being thrown down by sodium phosphate and weighed as pyrophosphate.

The mineral was separated from the associated impurities by placing upon a filter the total silica, which had been separated by evaporation with acid in the usual manner, and washing it seven or eight times with a hot concentrated solution of sodium carbonate. By this means all the soluble silica of the mineral was separated from any particles of quartz, orthoclase, or other insoluble silicates.

Regarding a part of the manganese as combined with sulphur, and deducting a proportionate amount of oxygen from the analysis, it will stand:

SiO_2	23.10	or, without gangue,	SiO_2	25.48
BeO	11.47		BeO	12.63
MnO	35.40		MnO	39.07
Al_2O_3	2.68		Al_2O_3	2.95
Fe_2O_3	2.05		Fe_2O_3	2.26
CaO	.64		CaO	.71
K_2O	.39		K_2O	.43
Na_2O	.92		Na_2O	1.01
Mn	7.73		Mn	8.66
S	4.50		S	4.96
Gangue	9.22			
	98.10			98.16

This result differs considerably from the analyses of Helvite heretofore published, and does not lead to the formula usually given to Helvite. It is desirable that further investigation should be made when more material is discovered.

Helvite has not previously been found in America.

APRIL 4.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

On Sagitta, etc.—PROF. LEIDY stated, that in a recent trip to Atlantic City, N. J., he for the first time met with the singular worm *Sagitta*. It occurred in large number in the same pond in which he had previously noticed *Balanoglossus*. Whether it was there at the time of his former visit he was unable to say, as the animal is as transparent as the water in which it lives, and may easily escape observation. His attention was accidentally directed to its discovery. Along the edge of the pond there were numerous linear white bodies, flaccid and motionless, which he at first took for fragments of a bleached alga. From the uniformity of their size he stooped to examine them more closely, when he noticed others in the water, more transparent, lying on the sand and occasionally moving suddenly and so actively as to send a little spray above the surface. On transferring some of these bodies to a vial he detected their nature. Subsequently the water was seen to swarm with the little creatures. They are exceedingly sensitive and quickly die after removal. In life they are perfectly transparent and colorless, and move actively at intervals with a sort of spasmodic jerk, bending the tail downwards and darting forward. After death they become flaccid, dull and white, and hence the appearance of the multitude of dead ones on shore.

The Sagitta is interesting as being one of those peculiar animals which have puzzled naturalists as to its exact relative position. It is now usually regarded as the representative of an order of worms with the name of Chætognatha.

A species, *Sagitta elegans*, has been described by Prof Verrill, as occurring at Wood's Holl, Vineyard Sound, and Gay Head, on the New England Coast, and he refers to a second undetermined species occurring in Vineyard Sound.

The Sagitta of Atlantic City appears to differ from the former, and also from all other described species found elsewhere, and may be readily distinguished from them by its greater number of mandibular hooks. It may be characterized as follows:

SAGITTA FALCIDENS. Animal transparent, colorless; body compressed, elongated fusiform, with two pairs of lateral hemielliptical fins, separated by intervals from each other and the broad obcordate caudal fin, which is truncated posteriorly. Head obcordate, about as broad as it is long. Pre-

oral series of spines, 6 or 7 in each, minute; postoral series 18 in each, successively decreasing. Mandibular hooks, from 11 to 14 in each series, usually 12, besides an immature one, scythe-shaped, yellowish brown in color. Length, about three-fourths of an inch; width, 1¾ to 2 mm. Head 1 mm.; caudal fin 1.5 to 1.75 mm. wide. Mandibular hooks 0.75 mm. long.

At the same time, as previously, numerous mounds of the *Balanoglossus aurantiacus* were observed. There were also noticed in the same pond, many projecting tubes of sand, which were found to contain *Clymena torquata.* Further, several specimens of *Glycera americana* were collected. On the shore of the pond in one place *Donax fossor* appeared to have its residence; and among *Solen ensis*, a single living *Solecurtus gibbus* was found.

APRIL 11.

Mr. S. FISHER CORLIES in the chair.

Twenty-three persons present.

A paper entitled "Description of new species of Terrestrial Mollusca of Cuba," by Rafael Arango, was presented for publication.

APRIL 18.

Dr. W. S. W. RUSCHENBERGER in the chair.

Thirty-four persons present.

Orthite from Amelia C. H., Va.—Prof. GEORGE A. KÖNIG communicated the discovery of orthite among the minerals occurring at the mica mine of Amelia Court House, Va. The speaker has seen only two fragmentary crystals, a large one, nearly four inches long by one inch wide and one-fourth of an inch thick. Both ends were broken. It presents the combination of a flat prism with the brachypinakoid. In the position of epidote the prism will be equal to a series of brachydomes. There is a pronounced cleavage parallel to the macro- and brachypinakoids and to the basal plane. The crystal is enveloped by a thin reddish brown crust of soft altered material, while the interior is pitch black and hard. Fracture uneven. A plate was cut parallel to the basal plane which only became green translucent at a thickness of $\frac{3}{1000}$ of an inch. It was found that a number of opaque small spots were scattered through the leek-green mass on a few spots showing strong polarization, which are probably hydromuscovite.

This section behaves like a uniaxial substance; it is dark with crossed prisms, and light when their position is parallel. The plane of the optical axes is therefore parallel to the basal plane.

Specific gravity at 17 $C^0 = 3,368$. A thin splinter boils up in the strong flame of a blow-pipe, and fuses to a dark blebby slag. With borax in O. Fl. a manganese bead. Decomposed by concentrated hydrochloric and also by moderately dilute sulphuric acid. Its composition is

SiO_2	=	32.90
Al_2O_3	=	17.80
Fe_2O_3	=	1.20
CeO_2	=	8.00
La_2O_3, Dy_2O_3	=	14.20
FeO	=	10.04
CaO	=	11.32
MnO	=	1.00
H_2O	=	3.20
		99.66

Yttrium and glucinum are not present; but a trace of uranium was determined.

APRIL 25.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

The death of M. W. Dickeson, M. D., a member, was announced.

The death of Chas. R. Darwin, a correspondent of the Academy, having been announced, the following were unanimously adopted:

WHEREAS, The Academy of Natural Sciences of Philadelphia, has heard of the death of Charles R. Darwin, F. R. S., of Down, Kent, England, be it

Resolved, That the Academy of Natural Sciences of Philadelphia hereby expresses its sense of the great services which have been rendered to science and scientific thought by Mr. Darwin, and of the great loss which it in common with the entire scientific world has sustained in his death.

Resolved, That the Academy desires to express its sympathy with the family of Mr. Darwin in their bereavement.

Resolved, That a copy of these resolutions be sent to the family of Mr. Darwin.

Dr. Chas. R. Schäffer was elected a Curator to fill the vacancy caused by the death of Dr. Robt. S. Kenderdine.

Dr. Thos. Moore was elected a member.

The following was ordered to be printed:—

DESCRIPTIONS OF NEW SPECIES OF TERRESTRIAL MOLLUSCA OF CUBA.

BY RAFAEL ARANGO.

Chondropoma deceptor Arango.

Testa umbilicata, oblongo-turrita, tenuiscula, costis longitudinalibus lirisque elevatis confertis decussata, pallide aurantiaca, fasciis interruptis rubris fere, sæpius obsoletis ornata; spira regulariter attenuata, sublate truncata; anfractus superstites 5 convexi, ultimus circa umbilicum angustum distincte spiraliter striatus; apertura verticalis, angulato-ovalis; peritrema duplex, internum nitidum, externum late patens, concentrice striatum ad anfractum contiguum angustatum, umbilicum lamina lata fornicata fere tegens. Operculum flavescens.

Longitudo testæ truncatæ 22–25 mill., diam. 10 mill., cum peritremata 15 mill.; apertura 7 mill. longa et 5 mill. lata.

Simile quoad umbilicum et testæ formam *Chondr. canaliculato*, sed bene distinctum ab hoc et *echinulato* atque *sinuoso* sculptura non asperata.

Habitat.—" Mogote de la Iagua " prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Chondropoma Hamlini Arango.

Testa umbilicata, oblongo-turrita, tenuis, nitens, liris spiralibus et costulis longitudinalibus æque distantibus echinatim decussata, rubella, fasciis interruptis rubro-fusciis (in ultimo anfr. 7) ornata; spira regulariter attenuata, late truncata; anfr. superstites 4, ultimus circa umbilicum angustum spiraliter substriatum; apertura verticalis, angulato-ovalis; peritrema simplex, nitidum, læve, expansum, sed ante anfractum contiguum angustatum eumque non attingens. Operculum rubellum.

Longitudo testæ truncatæ 15 mill., diam. 11 mill., cum peritremate 19 mill.; apertura 4 mill. longa, 3 mill. lata.

Habitat.—" Cerro de Cabras, vega de los Franceces dicta " prope oppitum Pinar del Rio.

Cylindrella triplicata Arango.

Testa subrimata, cylindraceo-turrita, solidula, remote filoso-striata, straminea; spira elongata, medio paulo ventrosior, apice plerumque truncata; anfr. 15–16 planiusculi, ultimus breviter

solutus, non carinatus; apertura subcircularis; peritrema album, undique æqualiter reflexum; sutura profunda, non crenulata.

Longitudo testæ integræ 14 mill., diam. 3 mill.

Columna interna fortis, lamellis 3 validis æqualibus parallelis munita.

Differt ab omnibus *Cylindrellis* cubanis forma columnæ internæ. Forma testæ similis est *C. liratæ* Jim. et *mixta* Wr.

Habitat.—" La Jagua " prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Cylindrella atropurpurea Arango.

Testa rimata, subcylindrica, tenuiscula sæpe breviter truncata, arcuatim costulato-striata, atropurpurea, nitens; sutura impressa, non crenulata, anfr. testæ integræ 13 vix convexiusculi, subæquales, ultimus breviter solutus, non carinatus; apertura subcircularis, intus fusca; peritrema continuum album, tenue, breviter expansum.

Longitudo testæ integræ 19 mill.; diam. 4 mill.

Columna interna simplicissima.

Comparata cum *C. pruinosa* Mor. differt magnitudine minori, colore, costulis confertioribus, peritremate magis expanso et præcipue columna interna simplici.

Habitat.—" La Jagua " prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Cylindrella colorata Arango.

Testa vix rimata, fusiformi-cylindracea, tenuis, oblique obsolete costulata, fuscula, basi fascia filari rufo-brunnea, in parte inferiori prope suturam in omnibus anfractubus conspicua ornata; spira elongata, sæpe breviter truncata, sutura subcrenulata; anfr. 13–14 planiusculi, ultimus fortius costulatus, solutus; apertura subovalis, plica columellari coarctata; peritrema album, expansum, non flexuosum.

Longitudo testæ integræ 24 mill., diam. 4 mill.

Habitat.—" La Chorrera " in Provincia Pinar del Rio.

Cylindrella infortunata Arango.

Testa non rimata, subfusiformi-turrita, tenuis, diaphana, chordato-costata, albida; spira breviter truncata, sutura profunda non crenulata; anfr. superstites 12, planiusculi, ultimus basi obsolete carinata; apertura et peritrema ? (unicum specimen fractum est).

Longitudo testæ sine anfractu ultimo imperfectæ 10 mill., diam. 3 mill.

Columna interna 3-plicata, plica superiori ampliori.

Habitat.—" La Chorrera " in Provincia Pinar del Rio.

Cylindrella prima Arango.

Testa rimata, cylindraceo-turrita, solidula, subconfertim obsolete costata, albida; spira supra medium sensim attenuata (in specimine unico) truncata; sutura crenulata; anfractus superstites 13, planiusculi, ultimus basi carinatus, antice breviter solutus; apertura obliqua, subcircularis; peritrema breviter expansum antice ob carinam subsinuatum.

Longitudo testæ truncatæ 17½ mill., diam. 4 mill.

Columna interna plicis 2 descendentibus ornata.

Habitat.—Cuba.

Cylindrella confusa Arango.

Testa rimata, cylindraceo-turrita, solida, confertim striata, albida; spira supra medium sensim attenuata, breviter truncata; sutura non crenulata; anfractus superstites 13, planiusculi, ultimus basi carinatus, antice breviter solutus; apertura subcircularis; peritrema breviter expansum.

Longitudo testæ truncatæ 16 mill., diam. 4 mill.

Columna interna lamellis 2 validis, superiori fortiori, lente descendentibus munita.

Habitat.—Cuba.

Cylindrella difficultosa Arango.

Testa rimata, cylindraceo-turrita, solidula, nitens, obsolete costulata, pallido-straminea; spira breviter truncata, sutura non crenulata; anfr. superstites 10, planiusculi, ultimus basi subcarinatus, non protractus; apertura ovalis; peritrema breviter et in margine sinistro minus expansum.

Longitudo testæ truncatæ 11 mill., diam. 2¾ mill.

Columna interna plicis 2 fortioribus ornata.

Differt a *Cyl. concreta* costulis, ultimo anfr. non soluto, columnæ internæ forma.

Habitat.—Cuba.

Cylindrella consanguinea Arango.

Differt a precedenti testa opaca, ultimo anfractu basi carinato et columna interna laminis 2 debilibus descendentibus munita.

Numerus anfractuum et longitudo testæ æqualis sunt illis speciei precedentis.

Habitat.—Cuba.

Cylindrella crassilabris Arango.

Testa rimata, subcylindrica, solidula, oblique remote lirata, fuscescens; spira breviter truncata; sutura subcrenulata; anfr. superstites 11, planiusculi, ultimus obsolete carinatus, breviter solutus; peritrema album, reflexum, præcipue in margine dextro.

Longitudo testæ truncatæ 12½ mill., diam. 3 mill.

Columna interna inferne lamina una debili munito.

Habitat.—Cuba.

Cylindrella conferta Arango.

Testa rimata, subcylindrica, solidula, subconfertim striata, albida; spira breviter truncata; sutura impressa, non crenulata; anfr. superstites 10 planiusculi, ultimus obsolete carinatus, breviter solutus; apertura subcircularis; peritrema reflexiusculum.

Longitudo testæ truncatæ 10 mill., diam. 2½ mill.

Columna interna simplex.

Habitat.—Cuba.

Cylindrella imparata Arango.

Testa non rimata, fusiformi-cylindracea, solidula, nitens, subconfertim obsolete striata, albida; spira regulariter attenuata, integra; sutura profunda, non crenulata; anfr. 17 planiusculi, ultimus subangulatus, breviter solutus; apertura subcircularis; peritrema reflexiusculum.

Longitudo testæ 16 mill., diam. 2¼ mill.

Columna interna lamellis 2 tenuibus circumvoluta.

Habitat.—Cuba.

Cylindrella propinqua Gundl.

Teste subrimata, cylindraceo-turrita, solidula, sublævigata, albida; spira plerumque truncata; sutura subcrenulata; anfr. superstites 11–12 planiusculi, ultimus basi non carinatus, antice striatus, breviter solutus, apertura subcircularis; peritrema reflexiusculum in margine dextro ob plicam interiorem plerumque subsinuatum.

Columna interna 3 plicata, plica superiori ampliori.

Propinqua *Cyl. cristallina* testa forma et sculptura, sed columna interiori omnino diversa.

Habitat.—Vinales in eodem loco cum *Cyl. capillacea.*

MAY 2.

The President, Dr. Leidy, in the chair.

Thirty-three persons present.

The death of Edw. Desor, a correspondent, was announced.

On Some Entozoa of Birds.—Prof. LEIDY directed attention to some specimens presented by Joseph Willcox, recently collected by him in Florida. One of the specimens is the head of a Snake-bird, *Plotus anhinga*, with a worm in sight, lying upon the brain; while several other detached worms of the same kind lay at the bottom of the vial. The worm in its singular habitation was discovered by Prof. Wyman, in Florida, in 1861 and 1867, an account of which is given in the Proceedings of the Boston Society of Natural History, volume 12, 1868. Prof. Wyman had kindly presented Prof. Leidy with a specimen of the head of the Snake-bird, with the worms lying on the brain. This he had valued as a memento of his friend, but it had, unfortunately, been lost in the fire at Swarthmore College, last autumn. Prof. Wyman states that the parasites were found coiled on the back of the cerebellum between the arachnoid and pia mater. The number varied from two to six or eight, or even more. In nineteen birds they were detected in seventeen. Mr. Wilcox found the parasite in four out of six birds examined. In the present specimen of a head, a single worm is enclosed between the two laminæ of the dura mater over the position of the interval of the cerebrum and cerebellum. As the parasite appears not to have been named, it was suggested that the name of its discoverer should be associated with it under the name FILARIA WYMANI.

The accompanying four vials contain numbers of worms obtained from the stomachs of the Snake-bird, the Cormorant, *Graculus dilophus*, the White Pelican, *Pelecanus trachyrhynchus* and the Brown Pelican, *P. fuscus*. All prove to be of the same species, the *Ascaris spiculigera*. Specimens of these were also formerly obtained by Samuel Ashmead, in Florida, from the White Pelican, (Proc. Ac. Nat. Sci. 1858, 112). The same, likewise, have been submitted for examination by Dr. Elliott Coues, who procured them from the White Pelican, on the Red River of the North. See Birds of the North West, 1874, 587.

On a Coprolite and a Pebble resembling an Indian Hammer.—Prof. LEIDY further exhibited a specimen which he had picked up from a pile of the irregular phosphatic nodules brought from Ashley River, South Carolina, for the manufacture of a fertilizer. The nodule, of several pounds weight, is a flattened oval black

mass, which he supposed to be the coprolite of a zeuglodont or cetacean.

He also exhibited a quartzite pebble, from a gravel bank in the University ground, West Philadelphia. It has a near resemblance to the stone hammers, with a groove around the middle, found in the ancient copper mines of Lake Superior. Notwithstanding this resemblance it is evidently a water-rolled pebble, the groove resulting from action on a softer stratum of the quartzite.

Historical Notes on the Arbor Vitæ.—Mr. THOMAS MEEHAN noted in detail the reasons given by various authors for the name *Arbor Vitæ* in connection with *Thuja occidentalis*—reasons unsatisfactory even to the authors who advanced them. He referred to the statement of Ray in his "Historia Plantarum" that the tree was first introduced from Canada to France and named *Arbre de Vie*, by King Francis the First. Francis died in 1547. The seeds from which these plants were raised could scarcely have been obtained in any other way than through Jacques Cartier's expedition, say in 1534, and we may, therefore, conclude that *Thuja occidentalis* was among the first, perhaps the first North American plant to become known in Europe. Parkman, in his "Pioneers of France," graphically describes the sufferings of Cartier's band during the winter of their encampment near the junction of the River Lairet with the St. Charles. Twenty-five died of scurvy and the rest were sick but two. A friendly Indian told him of an evergreen which they called "Annedda," a decoction of which was sovereign against the disease. In six days the sufferers had drunk a tree as large as a French oak, *Quercus ilex ?*, "the distemper relaxed its hold and health and hope began to revisit the hopeless company," (p. 195). This Annedda seems to have been identified with the White Spruce, *Abies alba*, and is, as I am informed by Dr. W. R. Gerard, the same as the Mohawk "Onnita," and the Onondaga "Onnetta." According to Rafinesque, the spruce beer of the Indians was made of the young tops and young leaves of this tree boiled together with maple sugar, and was one of their famous remedies for scurvy. Rafinesque also says that a decoction of the leaves of the Arbor Vitæ was an Indian remedy for scurvy and rheumatism; besides the leaves with bear's grease being used externally. Rafinesque, however, believes it was the White Spruce which saved the lives of Cartier's band, and if the "Annedda" of the Indians is really the White Spruce, the evidence through the statement made so soon after Cartier's expedition that the health-giving plant was the "Annedda," is strong. But spruce beer could not have been made in the winter season—the leaves only were used. There is no evidence that the White Spruce was known in Europe till towards the end of the 18th century. It is but natural that whatever the tree might have been, it was a veritable tree of life—an *Arbre de Vie*, to the voyagers. They would certainly make every effort to take with them to their native land

so valuable a tree. But we have no reason to believe that they attempted to introduce the White Spruce. There is, as we have seen, good reason to believe that Cartier took the *Thuja occidentalis* to Europe, and it is on record that his royal patron, a few years afterward, distributed the tree as the *Arbor Vitæ*, and, notwithstanding the seemingly positive evidence that the tree was the White Spruce, Mr. Meehan thought the *Thuja* had some ground for disputing the claim. At any rate, whatever may have been the real tree, he could not help suspecting that the name *Arbor Vitæ* had some relation to this touching episode in the history of the Cartier expedition.

May 9.

The President, Dr. Leidy, in the chair.

Twenty-seven persons present.

A paper, entitled "The Muscles of the Limbs of the Raccoon (*Procyon lotor*)" by Harrison Allen, M. D., was presented for publication.

The death of Chas. M. Wheatley, a member, was announced.

The death of Mr. Wm. S. Vaux having been announced, Dr. Ruschenberger read the following resumé of his services as an officer and member, and offered the appended resolutions, which were adopted:—

I sincerely regret to announce that Mr. William S. Vaux, the senior Vice-President of the Academy, died at his residence in the city, May 5, 1882, very near the close of the seventy-first year of his age. He was born May 19, 1811.

Mr. Vaux was elected a member of the Academy, March, 1834, and during more than forty-eight years served the Society effectually and generously. He was an Auditor thirty years, from December, 1856; a Curator forty-three years and four months, from December, 1838; a member of the Publication Committee, of which he was treasurer more than forty-one years, from December, 1840, and a Vice-President twenty years and four months, from December, 1860, excepting the year 1875.

His annual re-election to these important offices during all this time, implies that he discharged all his official duties satisfactorily to the Society.

During the construction of the hall, at the corner of Broad and

Sansom Streets, in which the Society held its first meeting, February 18, 1840, he was an active member of the Building Committee. He served in the same capacity when the building was extended in 1847, and in December, 1851, when it was determined to raise and improve the previously enlarged hall, a work which was completed December, 1855, he was elected a member of the Building Committee, and discharged all his duties efficiently.

In December, 1865, he was appointed a member of the Committee of Forty to solicit subscriptions for the erection of the hall now occupied by the Society, and in January, 1867, he was elected a member of the Board of Trustees of the Building Fund, and by it Treasurer of the Fund, and a member of the Building Committee, positions which he held when he died.

In all these building enterprises he was earnestly interested, gave liberally to all of them himself, and by his invitation and example influenced others to give. To the present building fund he contributed seven thousand dollars, the largest sum given by any individual.

Besides his gifts to the Building and other Funds, he contributed liberally to the museum, especially to the departments of mineralogy and ethnology, in which he was particularly interested, and also to the library.

This brief outline of his long and useful services and bounty to the Society is sufficient to indicate that the Academy has sustained a heavy loss by the death of Mr. Vaux. As a token of the Society's estimation of his worth, I submit the following resolutions:

Resolved, That the members of the Academy of Natural Sciences, of Philadelphia, deeply regret the death of the senior Vice-President, William S. Vaux, who was an experienced officer, a prudent adviser, and a steadfast and beneficent friend of the Society.

That in his death students of the natural sciences have lost a benevolent patron who contributed liberally to the means and facilities of study in possession of the institution.

That, as a message of condolence, a copy of these resolutions, attested by the President and Recording Secretary, be transmitted to his family.

May 16.

Mr. Meehan, Vice-President, in the chair.

Twenty-eight persons present.

Influence of Heat on the separate Sexes of Flowers.—Referring to his former observations, in which it was noted that less heat was required to advance flowers than leaves, and still less for male than for female flowers, Mr. Meehan called attention to a communication in an English scientific periodical, showing that the same facts may exist in the English climate as in our own. It appears that this season, according to the correspondent of Hardwicke's *Science Gossip*, the male flowers of the hazel-nut, *Corylus Avellana*, had been brought forward and perfected, before any signs of the female flowers appeared.

Liquid Exudations in Akebia and Mahonia.—Mr. Wm. M. Canby called attention to the exudation of moisture from the tips of the leaflets in *Akebia quinata*, a plant twining over a trellis near his porch dripped moisture enough to make the floor look as if sprinkled. An examination of the leaflets by Prof. Rothrock disclosed an arrangement of the tissue at the apex of each leaflet, evidently adapted to such an exudation. Mr. Meehan had been led by Mr. Canby's observations to watch closely a plant growing over a trellis on his house, confirming Mr. Canby's experience. The liquid globules on each leaflet were of the size of ordinary pin-heads. Their appearance was not constant, nor did there appear any regular period for the emission of the fluid. It was as likely to appear when the atmosphere was dry as when moist, or at midday as at evenings. The close relationship of *Lardizabalaceæ* to which *Akebia* belonged, to *Berberidaceæ*, led him to examine *Mahonia aquifolia*, flowering at the same time, and he found in many flowers just before expansion a small globule at the apex of the pistil, and in the same bud globules pressing through the divisions of the corolla. These would collect as they flowed out, and globules as large as peas, and of a quicksilvery hue, were not unfrequently found among the mass of flowers forming the densely fasciculated head. The fluid was of a viscid character. Only a few flowers exhibited the exudation at each examination, and he was led to believe that the flow in each flower was soon over. In *Thuja* there was also this sudden appearance of a small globule at the open mouth of the naked ovule, and which seemed to disappear very soon after its formation. In a large number of flowers examined only a few with globules at the apex were found at each examination. The liquid in this case did not disappear by evaporation, but seemed to be absorbed by

the nucleus. Sachs suggests a use for the exudation in coniferæ. The pollen is brought to the globule by the winds, and, as the moisture sinks within the vesicle, the pollen grain is carried to the nucleus, and fertilization is effected by actual contact. It would be extremely difficult for the pollen to affect the nucleus in *Thuja*, and some other coniferæ, as in ordinary flowers, in the absence of this liquid exudation.

Individual Variation in Species.—Mr. MEEHAN remarked on the prevailing tendency to look on striking variations in species as the result of hybridization. To his mind there were few species that did not exhibit a wide range of individual variation in some particulars, if we had good opportunities to look for them. He exhibited a series of cones taken from different trees of *Pinus rigida*, all gathered in Atlantic County, New Jersey, and pointed out how they each varied. Some double in length of their width, others conoid with a flattish base, others perfectly globular being rounded at both ends. Some had very narrow scales, and some half as broad as long, and again, some reflexed to a wonderful extent in drying, while some with the broad scales would only open to a very slight degree. Some trees would have cones several inches in length and width, while others had cones barely an inch long, and yet with perfect seeds. The cones were in a regularly graded order, the typical *P. rigida* at one end, at the other the cone would scarcely be distinguished from *P. serotina*. The intermediates then taken away from the central one left it to appear as a "hybrid" between the two.

Mr. Meehan said there was evidently a law of nature providing for individual variation. Whether this law of individual variation is distinct from that law of variation which resulted in the

THE MUSCLES OF THE LIMBS OF THE RACCOON (PROCYON LOTOR).

BY HARRISON ALLEN, M. D.

The genus *Procyon* is known to be one of the most ancient as well as one of the most generalized of the carnivora. The study of such a form when made in comparison with the more recent and more specialized genera, presents many features of interest. The following account of the muscles of the limbs has been undertaken with a view of ascertaining more especially what differences exist between these muscles and those of *Felis domesticus*,[1] and of man. Occasionally references to *Nasua fusca* were also made. Many variations in the human subject were found to correspond to the normal arrangement in *Procyon*. Since the subjects of nerve and muscle are intimately associated, not only anatomically but physiologically, it is stated from which nerve trunk each muscle derived its supply.

The material for dissection consisted of two adult females, obtained through the courtesy of Prof. Alexander Agassiz, of the Museum of Comparative Zoology, Cambridge, and of Mr. Arthur E. Brown, Superintendent of the Zoological Garden, Philadelphia.

THE MUSCLES OF THE SUPERIOR EXTREMITY.

(a) *Extrinsic Set.*

The Cephalo-humeral Muscle is a broad, flat, fleshy muscle arising from the occiput at its crest for a distance of eight lines, and from the ligamentum nuchæ for one inch and a quarter, that is to say, for a distance equal to one-half the length of the dorsum of the neck. The muscle passes obliquely downward over the front of the shoulder, and is narrowed gradually to be inserted by fleshy fibres into the linear ridge on the anterior surface of the humerus. It blends with the tendon of the Pectoralis Secundus —and indeed may be said to be inserted by fleshy fibres *upon* the lower part of the fibrous portion of this muscle. A tendinous inscription passes through the muscle opposite the head of the humerus. Connected with the under surface of this inscription

[1] When the domestic cat is referred to in the text the word "Felis" is used.

is a stout fascia, which passes over the head of the humerus and is lost on the acromion and the metacromion. This fascia embraces the lower third of the Levator Anguli Scapulæ and appears slightly at the lateral aspect of the Cephalo-humeral muscle.

The rudimentary clavicle is in close relation with this muscle. The under surface of the bone is occupied by a stout membrane which passes downward and forward to the axilla, where it is lost on the fascia covering the Subscapularis muscle. This membrane seems to support the Supraspinatus muscle, and separates the nerves of the arm from those of the region of the Scapula.

The Trapezius.—The upper division arises from the occiput at the median third of the superior curved line, and from the ligamentum nuchæ at its lower half. It is inserted upon the border of the spine of the scapula for its anterior three-fourths, and is continuous by an aponeurosis with the lower division over the remaining fourth. The lower division arises from the last cervical and the nine upper dorsal spinous processes, and is inserted directly upon the middle two fourths of the scapular spine, at the lower border, and indirectly (by reason of a union with the Infraspinatus aponeurosis) upon the remaining half of the spine. It is supplied by branches of the third and the fourth dorsal nerves.

The Levator Claviculæ arises from the occiput beneath the origin of the Splenius, passes downward along the side of the neck to be inserted upon the under surface of the tendinous inscription of the Cephalo-humeral muscle for its entire length, as well as upon the clavicle for its entire length. Its nerve-supply is by branches of the first trunk of the brachial plexus.

The Levator Anguli Scapulæ arises from the anterior half of the corresponding side of the body of the axis. It passes down the side of the neck to be inserted on the acromion, where its fibres are continuous with those of the Trapezius. It is supplied by branches from the first trunk of the brachial plexus.

The muscles usually called Trapezius and Levator Claviculæ in *Procyon* form parts of a single muscle, each of which bears to the whole a relation somewhat analogous to that which the different parts of the Pectoralis muscle bear to one another. As in the Pectoralis, they all influence the movement of the humerus and like it many of the fibres are not inserted directly into the humerus, but indirectly through the advent of membranous fibrous extensions.

But in addition to this the Levator Scapulæ and at least one part of the Trapezius, are inserted into the spine of the scapula, while the Levator Anguli Scapulæ, so called, is inserted into the acromion, so that the group is even less specialized than is the Pectoralis group, inasmuch as it is inserted into two bones of the anterior extremity, the scapula and the humerus. The Levator Anguli Scapulæ becomes superficial between the Cephalo-humeral and the scapular fibres of the Trapezius, while the Levator Claviculæ lies deep-seated beneath the Cephalo-humeral, and while being inserted at the tendinous inscription of the latter is in close relation to a thin fascial expansion that lies directly over the shoulder-joint. The Levator Anguli Scapulæ and the Cephalo-humeral muscles in their turn terminate in part upon an aponeurosis which passes over the Deltoid muscle and is lost on the Infraspinatus, the Teres Major and the Triceps muscles, and with which the epitrochlear slip of the Latissimus Dorsi is in intimate association.

This single great muscle, therefore, can draw the scapula and the humerus forward; through its traction on the clavicle make tense the subscapular fascia; through the fibres of the Levator Anguli Scapulæ make tense the sheath of the muscles of the extensor surface of the arm, and through the agency of the dorso-epitrochlear slip of the Latissimus Dorsi, the fascia of the rest of the upper extremity.

The Rhomboideus arises tendinously from the occiput seven lines from the median line. It arises, also, from the ligamentum nuchæ its entire length, and from the five upper dorsal spines. It is inserted with the Serratus Magnus at the upper border of the scapula for nine lines. The posterior third of the fibres at the vertebral border are coarser than the remainder. Some of the fibres pass upward upon the dorsum of the scapula. It is supplied by branches of the cervical plexus at the middle of the lateral border.

The Serratus Magnus arises from the transverse processes of the fourth, the fifth, the sixth and the seventh cervical vertebræ and from the first seven ribs. It is inserted into the vertebral border of the scapula its entire length.[1] Its nerve-supply is from the long thoracic.

[1] The vertebral border is separable from the anterior by being twice its thickness, and in being limited anteriorly by the triangular base of the spine.

The Latissimus Dorsi arises from all the dorsal spines, from the vertebral aponeurosis, and from the twelfth, the thirteenth and the fourteenth ribs. It is inserted into a linear rugosity on the shaft of the humerus, placed to the median side of the deltoid ridge, and behind the tendon of the endo-pectoral portion of the Pectoral muscle. The dorso-epitrochlear slip equals in width the Latissimus at its insertion. It arises by a broad origin from the Latissimus, just prior to the formation of its tendon, and is tendinously inserted upon the median margin of the olecranon for its entire length. The internal dorso-epitrochlear slip seen in *Felis* is here absent. A long, slender slip of the ventral border of the Latissimus is inserted upon the central axillary tendon. It is supplied by numerous branches from the intercostal nerves, and at the axilla by a branch of the brachial plexus.

The *Pectoralis Major* muscle is divided into two portions. That portion which is superficial at the ventro-anterior aspect of the thorax (Ecto-pectoral of Wilder) arises from the sternum, a little more than one-half its length, also from an intermuscular septum between it and the muscle of the opposite side, extending thence four lines from the sternum along the median line of the neck. It is inserted into the deltoid ridge of the humerus, and into the triangular space lying between this ridge and the head of the bone. At its distal end this muscle is inserted with the Cephalo-humeral. This portion is fleshy throughout, except at the under surface at its insertion. It represents the *P. primus*, *P. secundus* and *P. quintus* of other mammals. An imperfect attempt is made at the separation of the *P. quintus*, but none of the *P. primus*.

That portion which is deep-seated at the ventro-anterior aspect of the thorax (Endo-pectoral of Wilder) embraces a broad and imperfectly differentiated sheet of fibres pertaining to the Panniculus, and to a sternal mass. The two divisions fuse intimately, so that they need not be separately described. They together represent the *P. quartus* of other mammals.

The usual plan of description of a muscle may here with propriety be reversed, and the insertion described before the origin. Lying beneath the fibres of insertion of the superficial portion of the muscle is a thin fibrous sheet that is attached to the deltoid ridge, to the median side of the insertion of the superficial portion. It extends from this line upwards over the scapular tendon of the Biceps, and is lost in the capsule of the

shoulder-joint and in the fascia over the coracoid process, as well as that beneath the Subscapular muscle. It passes downward beyond the ridge, where it receives a few fibres from the superficial portion and is lost in the antebrachial fascia.

It is nearly as broad as long, and in every part is distinct from the superficial portion of the Pectoral. In this description of the Pectoral group the membrane will receive the name of the *fibrous membrane of insertion or the central axillary tendon.*

The pannicular division of the deep mass arises as a broad sheet from the superficial fascia of the trunk, its dorsal portion from the sacrum to over the scapula, and the ventral portion from over the middle line of the thorax. Its fascicles converge toward the axilla, some of them fusing with the lower margin of the sternal sheet, and others ending on the posterior margin of the fibrous membrane of insertion. Others yet are inserted about the middle of the under (ventral) border of this membrane of insertion.—The sternal sheet arises from the sternum at the lower border of the superficial portion, which overlaps it, to the base of the ensiform cartilage, as well as from the subcutaneous tissue at the præcordium. It is a ribbon-shaped, fleshy muscle, and ends on the membrane of insertion by distinct fibres, and is continued over it to the deltoid ridge. These fibres are free from the membrane at the upper half of the line of insertion. Placed between the pannicular and the sternal sheets, a third fascicle is received, viz., a marginal slip from the Latissimus Dorsi.

Arising from the lower margin of the membrane of insertion, is the median dorso-epitrochlear slip. It fuses with the Trapezius at its distal half. It is inserted on the median margin of the olecranon, and contributes to the formation of the antebrachial fascia.

Muscular fibres thus approach the aponeurosis of insertion of the deep portion of the pectoral from the skin of the back and abdomen, from the sternum and from the Latissimus Dorsi. The lower margin of the membrane receives more fibres than the remaining portions, while the proximal parts receive none. The sternal sheet at its upper half tends to be specialized from the membrane, and throughout can be said to adduct the humerus. The pannicular sheet, together with the Latissimus slip, may be described as a tensor of the sheath of the Biceps and of the capsule of the shoulder-joint. The median dorso-epitrochlear slip protects the nerves of the upper arm.

The Pectoralis Minor (P. Tertius) arises from the second to the fifth costal cartilages inclusive, to the outer side of the sternum, and is inserted tendinously into the bicipital border of the great tuberosity of the humerus. It here forms the anterior part of the capsule, and is united with the Supraspinatus muscle. This muscle has been described in human anatomy as being inserted on the Supraspinatus, or as being continuous with it.

In *Procyon* no portion of either the Pectoralis Major or Pectoralis Secundus is inserted into the antebrachial fascia. The Pectorals are supplied by branches of the brachial plexus and of the intercostal nerves.

(*b*) *Intrinsic Set.*

The Supraspinatus and the Infraspinatus Muscles do not present sufficient points of difference as compared with the same muscles in other mammals to deserve special description. The Supraspinatus is, in great part, bilaminated, the interlaminate space tending to open forward. The origin of the Deltoid and the insertion of the Trapezius largely conceal the Infraspinatus. The nerves are received from the suprascapular nerve.

The Subscapularis is composed of three main sub-divisions. The most anterior of these arises from the anterior border of the scapula for its entire length, and the intermuscular septum between it and the Supraspinatus muscle. It is inserted into the humerus. It yields fibres of origin to the Coraco-Brachialis. Its fibres are parallel with those of the last-named muscle, and may be said to be physiologically in continuity with them. The tendons of the remaining subdivisions of the Subscapularis underlie the tendon of the first division.

The muscle is entirely free from insertion into the delicate capsule of the shoulder-joint. It is supplied by three nerves, each of which is a branch of the brachial plexus.

The Teres Major arises from the aponeurosis of the Infraspinatus, from the lower margin of the Subscapularis near the scapular angle, as well as from a small portion of the scapula at the upper end of the vertebral border. The muscle is tendinous where it overlies the humerus and is inserted beneath the Pectoralis Secundus, on the median side of the bicipital groove.

Directly back of the origin of the Teres Major lies the insertion of the Rhomboideus. The muscle is supplied by a branch of the brachial plexus.

Teres Minor.—This muscle is so intimately fused with the Infraspinatus as not to demand a separate description.

Deltoid.—The fascicle from the fascia over the Infraspinatus muscle joins the fascicle from the acromion at the distal half of the latter. The two fascicles thence continue as a single muscle to the humerus. The nerve-supply, which is from the anterior circumflex, is abundant. The most important fascicle would appear to be from the Infraspinatus fascia. The tendon receives the terminal fascicle on its outer surface, and its tendon of insertion lies in contact with the tendon of origin of the outer head of the Triceps.

The Triceps possesses four heads. The first arises from the scapula, as in man, by a thin tendon as broad as the muscular belly, and is inserted into the tip of the olecranon.

The second, or lateral humeral portion, from the lateral aspect of the neck of the humerus by a flat, thick tendon, one-fourth the greatest width of the belly. It is inserted into the tendon of the preceding, and into the olecranon on the lateral border, and into the ulna at its upper fourth, where it becomes continuous with the Profound Flexor as it arises from the posterior edge of the ulna. The second portion receives an accession of muscular fibres from the posterior median portion of the neck of the humerus. It joins the belly half way down the humerus.—The third portion arises by a flat, thin tendon from a median surface upon the humerus at its upper third. It merges in part with the small Coraco-Brachialis. It also arises from a distinct broad surface upon the border of the humerus between the epitrochlea and the upper border of the epitrochlear foramen. This slip is inserted into the olecranon and is merged with the origin of the Flexor Carpi Ulnaris. This is quite a frequent human anomaly.

The scapular head of the Triceps, with the internal humeral fasciculi, form parts of a single bilateral laminated sheet. The dorsal portion of this sheet is aponeurotic at and near the olecranon, and is continuous with the antebrachial fascia. The external humeral head from the proximal end is bilaminate one-half its entire length.[1]

[1] In *Felis* the internal humeral head is distinct from the scapular, and the bilaminate arrangement is in all parts of the muscle less evident than in *Procyon*.

Nerve-Supply.—The nerves of the Triceps enter the interlaminate spaces, there being one nerve for the scapular and the internal humeral heads, and a second for the external humeral head.

It is worthy of note that in *Procyon* the Triceps is inserted not only *behind* the elbow, but, by an aponeurosis, into the ulna in *front* of the elbow. Since the ulna cannot move and the insertion is chiefly on the lateral border, the bone, after being extended, is with the humerus rotated *inward* at the shoulder. In a word, the Triceps is an inward rotator of the entire extremity.

Anconeus arises upon the posterior surface of the humerus from the triangular space at the lower half of the bone. Its firmest attachment is on the lateral border. It also arises from the epicondyle, one line below the tip, directly to the outer side of the Extensor Carpi Ulnaris. Its fibres are inserted into the entire lateral surface of the olecranon, and the whole muscle keeps well to the lateral half of the joint. Nerve-supply: The long nerve to the Anconeus sends a branch to the external humeral head of the Triceps.

Biceps Cubiti arises by a single stout head from the coracoid process of the scapula. The muscle presents on the proximal half of both its anterior and posterior aspects a thin, glistening, fibrous surface, but at the distal half it is free from superficial fibrous tissue. The tendon of insertion is but one-third the length of the tendon of origin. It is inserted into the tubercle of the radius. This entire muscle is composed of a sheet which is so folded upon itself as to produce the effect of a pair of laminæ, joined at the lateral border. Three separate branches from the brachial plexus enter the muscle in the interlaminate space, as well as a fourth, which, indeed, supplies the muscle, but since it lies in the position of the musculo-cutaneous trunk of *Felis* and most mammals, may be identified with this nerve. It does not, however, pierce either this muscle or the Coraco-Brachialis, as in man.

Coraco-Brachialis arises from the coracoid process by a narrow tendon which winds across the ventral surface of the tendon of the Subscapularis muscle. The muscle increases in width as it descends, and is inserted by fleshy fibres into the humerus distally to the tendon of the Latissimus Dorsi. The fibres of insertion are in close connection with the fibres of origin of the median head of the Triceps muscle. It receives a long slender nerve from the subscapular group of nerves from the brachial plexus.

Brachialis Anticus arises by penniform fleshy fasciculi from the entire lateral surface of the humerus. It lies in juxtaposition with the Biceps. No fibres whatever arise from the front or median surface. The upper fibres are nearly vertical and the lower nearly horizontal. Its tendon passes beneath that of the Biceps, and is inserted upon the median surface of the ulna, below the elbow-joint. The Brachialis Anticus keeps the ulna in contact with the trochlea, while the Biceps flexes the forearm. It also assists the Biceps in this movement and keeps the ulna within the tract of flexion.

The Brachialis does not arise from all the surface of the humerus which it covers; the muscular fibres are connected with the bone along the margins of the muscle only. The slips extend the entire length of the median, but for a shorter distance on the lateral margin. It is inserted upon a smooth surface on the median aspect of the ulna below the coronoid process. It is thus seen that this is chiefly a lateral muscle as related to the axis of the humerus, and by its insertion on the innermost and posterior portions of the two bones of the forearm, pursues an oblique direction as a whole, from the origin to the insertion. A variation in man consists in the union of this muscle with the Supinator Longus.

Pronator Radii Teres.—This muscle arises from the front of the epitrochlea, a surface which it exclusively occupies, the remaining flexors lying below it. It is aponeurotic in origin, inferiorly, and is wholly tendinous at its insertion. The distal border of the tendon reaches the middle of the shaft of the bone. The Pronator is to the radius what the Brachialis Anticus is to the ulna. The nerve-supply is derived from a small branch of the median nerve.

Flexor Carpi Radialis arises in common with the Flexor Sublimis Digitorum, and with the fine fasciculi with which it is intimately fused. It is inserted into the base of the second metacarpal bone, beneath the origin of the Metacarpo-Phalangeal Flexors. It receives its nerve-supply from the median nerve.

Flexor Carpi Ulnaris arises by two heads; the first arises from the depression on the median side of the olecranon, where it is continuous with the aponeurotic slip from the median humeral head of the Triceps. and is inserted by a long and narrow tendon into

the pisiform bone. The second head arises from the epitrochlea of the humerus, passes down parallel to the foregoing, and is inserted into the pisiform bone to the median side of the first portion. The second head also arises from the epitrochlea in common with the Flexor Sublimis Digitorum. The muscle lies entirely upon the Flexor Profundus, and does not touch the ulna. The nerve-supply of the first head is very minute, and confined to the extreme proximal end of the belly. That for the second head is larger, branches being received from the ulnar nerve at three different points along the proximal half of the belly.

It is evident that in *Procyon* the two divisions of the Flexor Carpi Ulnaris usually described are equivalent to distinct muscles. Unlike the arrangement seen in *Felis*, no attempt at fusion between the ulnar and humeral heads is seen, while the tendency for the humeral head to fuse with the superficial flexor is seen in both forms, though to a much less degree in *Procyon* than in *Felis*.[1]

Palmaris Longus.—The Palmaris Longus was double in one specimen, both portions arising in common with the Flexor Sublimis Digitorum.[2] In the other specimen it was found to be single, and the nerve-supply little or none.

Flexor Sublimis Digitorum.—This muscle arises from the epitrochlea. It soon divides into two portions. One of these passes without division to the Flexor Profundus Digitorum; the other, the main muscle, divides into two parts, one of which is inserted into the first and the second toes, and the other on the third and the fourth toes. The slips for the first and the second toes divide into two slips, one for each side of the sheath of the deep flexor at the first phalanx. In one specimen, the first toe received no slip.

The nerve-supply is from a small branch of the median nerve.

[1] The connection between the insertion of the muscle and the fifth metacarpal bone is much less decided than between the Extensor Carpi Ulnaris and the same bone. Such connection has been omitted as part of the essential description of the muscle.

[2] The Extensors lie successively along a ridge (supracondyloid ridge). The flexors are collected in a "bunch" at a process (not a ridge), the Pronator Radii Teres excepted. This muscle lies by itself above and in front of the "bunch."

The failure of the superficial flexor to support the sheaths of the third and fourth digits, may occur as an anomaly in man.[1]

The Flexor Profundus Digitorum arises in a penniform manner from the ulna, as follows: 1st, from the concavity on the median surface of the olecranon; 2d, from the posterior border of the ulna at the upper third; and 3d, from the median surface of the ulna at its middle third, near the distal end. The second portion derives some fibres from the membranous expanse of the Triceps on the lateral surface of the olecranon, and the intermuscular septum between it and the Extensor Indicis. Its tendons pass to the four outer toes. The under part of the tendon at the wrist is smooth.

Macalister[2] does not mention the union with the Triceps tendon. This might be found to vary in man. The nerve-supply of this muscle is from the median nerve.

The Flexor Longus Pollicis is composed of two separate portions, a superficial and a deep. The superficial portion arises in common with the Flexor Carpi Radialis from the epitrochlea. It is fleshy for the upper third of its course, and joins the Flexor Profundus Digitorum at the lower border of the annular ligament. Just prior to the formation of the tendon, muscular slips join the bellies of the Flexor Sublimis Digitorum and the Flexor Profundus Digitorum. Below the annular ligament the tendon for the thumb leaves the Profundus and passes to the second phalanx. From this tendon arises a Lumbrical muscle. A large slip passes from the fleshy portion to the tendon of the deep flexor just above the annular ligament.

The deep slip is penniform in character. It arises from the radius at its upper third, and joins the conjoined tendon at the upper border of the annular ligament. The last-named slip is evidently homologous with the anthropodean muscle of the same name. The nerve-supply is from the median.

It is interesting to note that the variations of this muscle in the human subject include in essential features the above arrangement. Mr. Carver[3] describes as arising partly from the Profundus

[1] In *Nasua fuscus* the slips of union between the superficial and the deep flexor are *three* in number, and are inserted on the conjoined tendon above the annular ligament. The union of the Sublimis with the Profundus occurs below the tendon.

[2] Trans. Royal Irish Acad., xv, 1872.

[3] Jour. of Anat. and Phys., iii, 260.

and partly from the Sublimis, a small muscle which became tendinous, and, just above the annular ligament, divided into two portions, one for the Flexor Pollicis, and one for the Profundus slip for the index finger. Excepting the slips from the Sublimis, this follows the plan in *Procyon*, the division in the latter occurring higher up. The lumbrical slip also is repeated as an anomaly in human myology (Wood and Macalister). The origin of the muscle from the epitrochlea, instead of from the radius, is a common human variation. The origin in common with the Flexor Carpi Radialis is, so far as I know, not repeated in man.

The Extensores Carpi Radiales Longior et Brevior, are as in man; the Brevior is the stronger of the two, and is confluent above with the Extensor Communis Digitorum.

It is supplied by the posterior muscular branch of the musculo-spiral nerve before it pierces the Supinator Brevis. The nerves spread on the under surface by short, single trunks at the proximal end.

The Supinator Brevis arises from the orbicular ligament by a narrow tendon, and is inserted upon the upper third of the radius. This is the arrangement in Gruber's Tensor Ligamentum Orbicularis Anterior of Man. He found it in fifteen cases in one hundred. This muscle is pierced by the posterior muscular branch of the musculo-spiral nerve, and receives from it its nerve-supply.

The Supinator Longus, much narrower than in *Felis*, arises muscularly from the upper end of the upper third of the Supra-condyloid ridge, and is inserted tendinously upon the distal end of the radius. Its sparse nerve-supply is confined to a single small branch to the proximal end, derived from the posterior muscular branch of the musculo-spiral prior to its piercing the Supinator Brevis muscle.

The Extensor Communis Digitorum arises from the supra-condyloid ridge between the Extensor Carpi Radialis Brevior, and the Extensor Minimi Digiti, and is in common therewith. It soon, however, separates from them, and, forming a tendon, divides beneath the annular ligament into four small tendons. These reunite upon the dorsum of the carpus to again separate and pass to the dorsal surface of the first phalanx of each toe. It is supplied from the posterior branch of the musculo-spiral nerve.

Extensor Carpi Ulnaris arises from the external condyle of

the humerus by a relatively broad tendon. The flat, weak belly terminates obliquely on a broad, stout tendon of insertion, which is attached to the lateral border of the pisiform bone at the base of the fifth metacarpal bone. The connection with the pisiform bone is more exact than in *Felis*, but in addition to fixing the pisiform the tendon seems to make tense the dorsal aponeurosis. It is largely ligamentous in action, and probably protects both the elbow and the wrist-joints.

Nerve-Supply.—Nerves are received on the median border by three distinct trunks. They are thus more numerous than those to the flexors of the carpus and of the fingers. The nerves arise from a little close network which also supplies the Extensor Communis Digitorum, and is derived from a branch of the musculo-spiral, which penetrates the Supinator Brevis.

Extensor Ossi Metacarpi Pollicis occupies the interval between the ulna and the radius, and arises from the proximal end of the distal half of the latter, and along the shaft of the former from the side of the olecranon to near the distal extremity. The muscle below the oblique ligament is penniform, the long oblique ulnar fibres joining the medianly-placed tendon, which winds around the distal third of the radius, lying in the pronounced groove at the wrist-joint, and is inserted into the median aspect of the proximal end of the first metacarpal bone. In one specimen the muscle was bi-penniform, the muscular fibres arising from the radius being inserted into the tendon to the median side. The weak nerve-supply of this muscle is derived from the posterior branch of the musculo-spiral, the nerves entering upon its upper free surface.

The Extensor Minimi Digiti arises from the supracondyloid ridge to the outer side of the preceding muscle, which it resembles in its general features, also from the orbicular and external lateral ligaments of the elbow-joint, and passes beneath the annular ligament by a distinct sheath, viz., over the distal end of the ulna. The tendons do not reunite after the first separation, but are inserted upon the lateral surfaces of the first phalanges of the three outer toes. The slip to the fifth toe is not distinct from the rest of the muscle as in *Felis*.[1]

[1] In *Nasua fuscus* the E. M. Digiti tends to unite with the Extensor Communis Digitorum, but subsequently separates therefrom before insertion.

The Extensor Indicis arises from the lateral aspect of the ulna just below the olecranon, and, for a slight distance, from the septum between it and the Flexor Profundus. Its tendon passes parallel to the ulna, and reaches the manus by running beneath the tendon of the Extensor Communis Digitorum beneath the annular ligament. The tendinous slips are inserted upon the first, the second and third fingers to the lateral side beneath the three tendons of the Extensor Communis. The muscle receives a tendinous slip from the Extensor Minimi Digiti, and is thus an abductor, and assists the Extensor Carpi Ulnaris and the Extensor Minimi Digiti. It receives two branches from the posterior muscular branch of the musculo-spiral nerve.

Pronator Quadratus extends from the middle of the forearm to the proximal border of the distal epiphysis of the radius and of the ulna. It is broader toward the wrist than toward the elbow where its fibres are pale and inconspicuous. The radial fibres are not concealed by the stout aponeurosis so conspicuous in *Felis*. The nerve-supply is from a deep branch of the interosseous.

Palmaris Brevis arises as a single slip from the annular ligament and is lost over the base of the fifth toe.

The Intrinsic Muscles of the Manus embrace the following:—

The Opponens Hallucis.—This insignificant fascicle arises from the fibrous tissue over the sheath of the Flexor Carpi Radialis, and is inserted into the proximal end of the first metacarpal bone. It is upon the same plane with some of the fibres of origin of the first Metacarpo-Phalangeal Flexor.

The Palmar Interossei.—These muscles are three in number. The first and the third, passing respectively to the first phalanx of the hallux and the first phalanx of the annularis, are twice as broad as the second, which goes to the first phalanx of the index finger. These all arise from the fibrous tissue over the proximal ends of the metacarpal bones.

Opponens Minimi Digiti arises in common with these muscles to the lateral aspect, and is fused at its proximal third with the third muscle. It is inserted into the distal end of the metacarpal bone.

Flexor Brevis Minimi Digiti arises from the annular ligament and is inserted into the sheath of the Flexor Profundus Digitorum by a structure exactly similar to that found in the pes.

Abductor Minimi Digiti arises from the pisiform bone and ends by a long aponeurotic tendon upon the sheath of the first phalanx of the fifth toe in its lateral aspect. The muscle receives an accessory slip from the connective tissue beneath the deep flexor.

The Metacarpo-Phalangeal Flexors.—Each arises from the metacarpal bone of the corresponding toe and is inserted into the sesamoid bone of the metacarpo-phalangeal joint. The fifth toe alone possesses the Dorsal Interosseus, and even in this instance the muscle is in great part fused with the flexor muscle. For the remaining toes the Dorsal Interosseus is undifferentiated, yet latero-dorsal slips of tendon connect those parts of the flexor muscles seen from above in the intercarpal spaces, with the sides of the sheaths of the digits. As in the pes, so in the manus the divisions between the two portions of the flexors are more pronounced in the hallux and annularis than in the remaining toes.[1]

The Muscles of the Inferior Extremity.

(a) Extrinsic Set.

Quadratus Lumborum.—This muscle has not been differentiated from the vertebral series in *Procyon*. On the ventral aspect a flat slip is seen arising from the second lumbar vertebra on a line with the origin of the transverse abdominal muscle. It passes upward and outward to be inserted on the last rib at about its middle. A second flat slip, lying a little below the preceding, and on a deeper plane, appears to be a cleavage from the internal oblique abdominal muscle. It arises from the ventral aspect of the Longissimus Dorsi, and is inserted into the last rib at its

[1] The Lumbricales, Palmar and Dorsal Interossei muscles of *Procyon* may be described as inserted into the sheath of the digit. In the manus of the Macaque this was seen to be the case also. It will be remembered that in human anatomy the Dorsal Interossei are described as having their insertions into the extensor tendons of the digits as well as into the base of the first phalanx of each finger. It is probable that the simplest expressions of these muscles in mammals are as *tensors of the sheaths* of the digits on the dorsal and lateral surfaces, and that their connection with the tendons of the extensors of the fingers is not an essential one. Indeed the extensor tendons themselves may be said to end upon the same sheath, the latter being described as enveloping each digit like the fingerstall of a glove. It is free everywhere between the interphalangeal joints above and at the sides, but is closely incorporated with the capsules of the last-named joints as well as with the sheaths of the flexor tendons.

ventral third. These two slips are, perhaps, representative of the costal fibres of the Quadratus. The ilio-vertebral fibres are represented by an imperfectly differentiated slip, extending from the ventral aspect of the iliac crest to the transverse processes of the last lumbar vertebra.

The Longissimus Dorsi is very conspicuous from the ventral aspect of the trunk, and doubtless affords the generalized mass from which the Quadratus Lumborum of human anatomy has been evolved.[1]

Psoas Minor arises from the ventral surfaces of the bodies of the first three lumbar vertebræ, and is fused with the Psoas Magnus. It is inserted by a broad, glistening aponeurosis into a pronounced ridge of the ilium, directly above the ilio-pectineal eminence.

Psoas Magnus arises from the bodies of the third, fourth and fifth lumbar vertebræ, and the anterior surface of the corresponding transverse processes. After being joined by the Iliacus Internus, its tendon is inserted, after winding around the neck of the femur, into the trochanter minor. Both the Psoas muscles are perforated by a branch of the lumbar plexus, the Psoas Magnus being more particularly supplied by a number of short filaments from the anterior crural nerve.

Iliacus Internus arises by a long slip the entire length of the iliac fossa, and by a broad sheet of fibres extending across the venter of the ischium below the attachment of the ilio-lumbar fascicle of the Quadratus Lumborum, and also by a thin slip directly above the origin of the Rectus Femoris. The muscle is not confined to the pelvis. The anterior margin overlies the origin of the Tensor Vaginæ Femoris and of the Rectus Femoris. It is fused with the Psoas Magnus at the upper margin of the acetabulum.

The Psoas Magnus and the Psoas Minor unite with the vertebral mass, from which they are imperfectly differentiated, in forming a powerful vertebral flexor, which can be traced upward behind the pleura as far as the body of the ninth dorsal vertebra. The Psoas Magnus can be divided into several imperfectly defined laminæ, the interspaces between which carry the branches of the lumbar and sacral plexuses.

[1] The muscle last named is here included, for while acknowledged to be a trunkal muscle it has important relations to the innominate bone.

Gluteus Maximus.—The Gluteus Maximus arises from the ilium, the vertebral aponeurosis, the lateral margin of the sacrum and the transverse process of the first caudal vertebra. The iliac origin is membranous, its under surface being in intimate union with the Gluteus Medius. The sacral origin is musculo-tendinous, as is that from the first caudal vertebra. The common sheet formed by the union of the two surfaces last named, affords origin for a slip of the Lateral Caudal muscle. The margins of the Gluteus are muscular throughout their entire length, but the muscle becomes tendinous as it overlies the trochanter major. It is in close connection if not continuous with the upper margin of the Quadratus Femoris at its insertion. The Gluteus Maximus is inserted into the third trochanter, which lies rather upon the anterior than upon the lateral surface of the femur, and by a well-defined slip into the fascia lata.

The anterior border of the Gluteus Maximus is inseparable from the corresponding border of the Gluteus Minimus.

The nerve-supply of the Gluteus Maximus is derived from branches piercing both the Gluteus Medius and the Gluteus Minimus near their anterior borders: the longest branch (arriving from the great sciatic nerve) lying on the under surface of the muscle, corresponding pretty accurately to that portion arising from the sacrum and the first caudal vertebra. In addition to these nerves the muscle receives several branches of the Inferior Gluteal nerve. The entire muscle easily resolves itself into two portions, which, however, cannot be separated by the knife. The anterior portion, of iliac origin, receives nerves by distinct Gluteal branches, and becoming fused with the Gluteus Medius, rotates the femur inward; while the posterior portion arises entirely from the sacrum and first caudal vertebra, fuses with the Tenuissimus, and, receiving the distinct and very long gluteal branch already mentioned, rotates the femur outward. The last-named muscular portion is extrinsic to the posterior extremity, while the first-named is intrinsic.[1]

[1] That portion of the Gluteus Maximus described as the second part in *Felis*, was not present in *Procyon*. The caudal or ventral origin of the Biceps Femoris would appear to compensate for its absence. The second part of the Gluteus Maximus of the cat is, in all probability, the same as the high origin of the Biceps Flexor, since it can be traced directly to the intermuscular septum between the Vastus Externus and the Adductor Magnus, and is continued thence to the capsule of the knee-joint.

Gluteus Medius.—The Gluteus Medius arises from the dorsum of the ilium, the under surface of the aponeurosis of the G. Maximus, and, by a separate set of fascicles, from the lateral border and the anterior surface of the sacrum. Fibres pass downward to be inserted into the great trochanter. Posteriorly this muscle is divisible into two planes which anteriorly are fused. The anterior portion is iliac in origin, and is inserted into the trochanter major. Superficially it is supplied by nerves in common with the G. Minimus. Its interior is fibrous. The posterior portion, slightly overlapped by the anterior, arises from the sacrum and is supplied by nerves passing directly from the sciatic at the great sacro-sciatic foramen. It is also supplied on the dorsal surface by a nerve escaping from the great sacro-sciatic foramen in common with the superior gluteal, but distinct from it. This portion of the G. Medius is inserted into the great trochanter as it borders on the digital fossa.

It is evident that a parallel can be here instituted between the G. Maximus and the G. Medius. The sacral part of each muscle can easily be distinguished from the iliac portion. In the case of the G. Medius the division has gone so far as to form the outline of two distinct muscles, but which are not completely separable the one from the other.

Gluteus Minimus.—The Gluteus Minimus arises from the dorsum of the ilium below that surface occupied by the G. Medius. It fuses anteriorly with the G. Maximus. This fusion enables the observer to classify the G. Minimus as a deep lamina of complex muscle, of which the G. Maximus is a superficial lamina, the two planes of cleavage being in this instance so remote from one another posteriorly, as to permit so large a muscle as the G. Medius to be received between them. The same disposition toward planal cleavage witnessed in the G. Medius is also found in the G. Minimus; the superficial lamina, however, is quite rudimentary, and is confined to the anterior fifth of the dorsal surface. Between the two laminæ passes a large trunk from the superior Gluteal set of nerves which supplies both the G. Medius, G. Minimus and ultimately the anterior part of the G. Maximus. The G. Minimus is inserted in the anterior edge of the trochanter major by a narrow glistening tendon, and is in close relation to the hip-joint.

Tensor Vaginæ Femoris.—The Tensor Vaginæ Femoris arises

from the ventral edge of the ilium on a line with and immediately posterior to the Sartorius. It arises by a thin membranous tendon on a level with the great trochanter at the middle of the thigh, and ends in the fascia lata. It does not fuse with the muscles of the Gluteal group.

The structure last named is continuous with the fibres of insertion of the Biceps Femoris at the side of the knee, but is not in a line with the head of the tibia, but rather with the side of the patella. The nerve-supply is probably from the inferior gluteal; the dissection did not permit of an exact identification.

(*b*) *Intrinsic Set.*

The Biceps Femoris.—The Biceps Femoris arises by a broad stout aponeurosis from a spine of the sacrum,[1] and by a musculo-tendinous mass from the tuberosity of the ischium. The muscle forms a broad sheet of fibres over the outer side of the thigh and ends in a second aponeurosis at the lateral margin of the patella, and the head of the tibia. At a point about on a level with the head of the tibia, a slender fascicle is given off that passes over the leg superficially and joins the Soleus, and with the last-named muscle contributes to the formation of the Tendo-Achillis. Beneath the Biceps lies the Tenuissimus. This arises from the under surface of the Gluteus Maximus, and passing down over the sciatic nerve is lost over the fascia of the leg.

The Biceps was found in one dissection to present variation from the above description. The body of the muscle as it arose from the ischium divided into two portions, an anterior and a posterior. The anterior, larger—and at the ischium the more superficial portion—was inserted entirely upon the side of the patella and the external tibial condyle. The posterior portion became superficial about six lines below the tuberosity, and was inserted by a broad, thin surface on the fascia of the leg, and, finally, instead of joining the Soleus, was continuous with the Gastrocnemius at the beginning of the tendo-Achillis. The Tenuissimus instead of arising from the Gluteus Maximus, arose from its tendon of insertion into the third trochanter. It passed to the posterior division of the Biceps, along the hinder border of which it descended to the fascia of the leg.

[1] In Ursus, according to the figure in Cuvier and Lieutaud, this slip is absent.

An examination of the variations of the Biceps Femoris (Biceps Flexor Cruris) results in adapting the above description in its several parts to human anatomy. Sömmering describes the muscle with a second long head from the tuberosity of the ischium; Meckel with a third head from the upper portion of the linea aspera; Wood describes a head arising from the fascia beneath the Gluteus Maximus. This is evidently the same as the Tenuissimus. A slip continuous proximally to the sacrum, has been recorded by Theile and Macalister. A slip may be attached to the external condyle of the tibia. A slip may be inserted in the fascia of the leg, or one may join the tendo-Achillis.

It is further interesting to note that the muscle is variable in *Procyon* as well as in the human subject. In one specimen the Tenuissimus, which may be regarded as homologous with the femoral head of the human muscle, was attached to the femur, while it is commonly seen arising from the Gluteus Maximus. The fact last named would indicate that the muscle is of the same relative value as one of the muscular slips passing between a superficial and a deep muscle of the same group, as instanced in the fascicle occasionally seen passing between the superficial and the deep flexors of the fingers. It is supplied by a separate branch of the sciatic as well as by branches in common with the Biceps. The nerve-supply of the Biceps consists of great numbers of minute branches from the lesser sciatic and its anastomosis with the obturator nerve.

The Semitendinosus.—This muscle arises from the upper end of the tuberosity of the ischium, and by a fleshy slip from the posterior margin of the aponeurosis of the Biceps. The last-named slip joins the main belly at its upper third. The muscle is inserted on the anterior surface of the tibia at its upper third. Its tendon, as is usual, lies directly beneath the tendon of insertion of the Gracilis.

The Semitendinosus, while arising in great measure in common with the Biceps, is inserted on the opposite side of the limb. The nerve-supply is from the sciatic.

The Semimembranosus arises from the entire posterior margin of the innominate bone, excepting a portion a few lines in length near the symphysis, which is occupied by the origin of the Adductor Magnus. It forms in reality two muscles. The first of these —ischio-tibial—arises as a flat band of tendinous fibres from the

tuberosity of the ischium and is inserted into the tibia at the inner tuberosity. The second—the ischio-pubio-femoral—arises from the remaining portion of the posterior margin and is inserted into the femur above the external condyle. Uniting the two is a long fusiform slip, which arises from the ischium above and is inserted with the other division into the femur.

The nerves of the Semimembranosus are numerous and large. The ischio-tibial is supplied by a distinct trunk from the great sciatic nerve. The ischio-pubio-femoral by both this nerve and the obturator. A long branch of the nerve first named runs along the femoral division to its distal third, where it anastomoses with a branch of the anterior crural nerve.

Sartorius.—The Sartorius muscle arises from the anterior superior spinous process of the ilium, by a rough angulated border equalling in length one-third of the anterior border of the ilium, and from a fibrous membrane continuous with the External Oblique muscle of the abdomen. The muscle is broad and ribbon-shaped and is inserted into the capsule of the knee-joint toward its median surface, including the median border of the patella, and passing thence downward to the tibia, where it is inserted membranously on the anterior surface, for nearly one-half the length of the shaft. On the same plane, it is in intimate union with the insertion of the Gracilis. Beneath this plane lies the insertion of the Semitendinosus. The Sartorius is supplied at its upper third by the anterior crural nerve, and at its lower fifth by a deeper-seated branch from the same nerve.

Gracilis.—The Gracilis arises tendinously from the entire length of the symphysis, and muscularly by a thickened border from the descending ramus of the pubis. It is inserted at the median side of the patella, the median tuberosity of the tibia and the corresponding border of the tibia at its proximal third. It is freely supplied both at the proximal and the distal portions by branches of the anterior crural nerve.

Adductor Magnus arises from the lower half of the symphyseal line, the pubis at the beginning of the descending ramus and the under surface of the Gracilis. It is inserted by fleshy fibres into the entire posterior surface of the distal half of the femur. The fibres of insertion form three distinct fasciculi, one, representing the median cord that in the human subject, passes to the minute tubercle above the epiphysis, but which is here fleshy and dis-

tributed over the posterior surface. The remaining portions lie nearer the lateral margin, one of them directly upon it. The nerves are derived from the anterior crural and the obturator.

Adductor Longus arises from the symphysis and the pubic half of the ilio-pectineal line. It is inserted into the femur by an oblique line near the median border. It is supplied by nerves from the anterior crural.

The Pectineus and the Adductor Brevis arise from the ilio-pectineal line, but not from the bone between this line and the acetabulum. They are both inserted tendinously on the A. Longus, but nearer the lateral border. Their nerves are derived from the anterior crural.

Quadriceps Extensor.—The Rectus arises over the acetabulum by a single head. At its proximal seventh the muscle is tendinous and overlaid by the Psoas. It is free throughout, except at the lower fourth of the outer side, where it is joined by the Vastus Externus. It is protected by a sheath derived for the most part from the Vastus Internus. On this sheath is inserted the Tensor Vaginæ Femoris.

The Vastus Internus and Vastus Externus form a continuous mass at the lower third of the thigh, behind the Rectus. They are free from the femur at its upper half; the V. Internus arises for the most part from the front of the shaft of the femur at the base of the trochanter minor, and by a continuous small fleshy line from the entire length of the front of the bone. It is continuous with the Crureus. The V. Externus, V. Internus and Crureus form a muscular bed which is fibrous at its lower half. The nerve-supply of the Quadriceps Extensor is derived from the anterior crural nerve. In addition the Vastus Externus receives four or five branches from the lesser sciatic nerve.

Quadratus Femoris.—The Quadratus Femoris is a stout muscle arising from the tuberosity and the ramus of the ischium, and inserted into the posterior surface of the femur by a rugose crescentic line. It is supplied by a distinct nerve from the great sciatic, which in proportion to the size of the muscle is unusually large.

Obturator Externus.—The Obturator Externus arises from the border of the obturator foramen externally, the descending ramus of the pubis and the ramus of the ischium, and passes forward to be inserted by a tendon which is superficial at its distal half

into the anterior half of the digital fossa. In the anterior part of the muscle is seen an imperfect attempt at the formation of two laminæ. The tendon is here concealed to a greater degree than elsewhere. The muscle receives its nerve-supply from the obturator nerve.

Obturator Internus.—The Obturator Internus arises from the entire inner surface of the innominate bone for a distance equalling the extent of the symphysis pubis. Save at its extreme anterior margin and the trochlear surface as it winds round the border of the ischium, the muscle is fleshy throughout. Both Gemelli muscles are well developed and are fused in front of the main tendon. The muscle is intimately connected with the capsule of the hip-joint and is fused at the insertion with the tendon of the Obturator Externus. The Obturator Internus receives nerves within the pelvis from the internal pudic, and the Gemelli from a separate trunk destined for the Quadratus Femoris.

The Gemelli form a deep lamina of cleavage from the main mass of the Internal Obturator which represents a superficial layer of the same muscle.

Gastrocnemius.—This muscle arises from the femur by two heads. The outer head bears a sesamoid bone.—The fibrous tissue between the femur and this bone are exceedingly stout and coarsely fasciculated. A thin fascia-like membrane extends from the lateral surface of the capsule of the knee-joint to the superficies of the sesamoid. This is continuous with the Vastus Externus muscle, so that when traction is made upon the muscle last named the sesamoid can be moved slightly upward. This muscle, therefore, can aid in fixing the bone at times when the Gastrocnemius and the Plantaris contract. The bone is also supported by bands extending to it from the posterior surface of the capsule.—The outer head of the Gastrocnemius is pierced by a branch of the sciatic nerve to supply the Soleus on its superior surface. Fusing with the under surface of the outer head is the origin of the Plantaris muscle. The inner head is of muscular origin and ribbon-shaped, and is attached directly to the femur without the intervention of a sesamoid bone. The two heads of the muscle fuse at the upper third of the leg, forming a flat, triangular surface which gradually becomes tendinous toward the apex of the triangle to form the tendo-Achillis.[1] An unusually large bursa

[1] There is no slip of origin from the fascia over the head of the fibula as in *Felis*.

intervenes between the concave tuber calcis and the tendon. Under the head of the Biceps muscle it has already been mentioned that the Gastrocnemius may be reinforced by the lower part of this muscle.—The Soleus arises from the head of the fibula only, by a musculo-tendinous origin. It is fusiform, much thicker, and in every way more robust than the Gastrocnemius, and joins the tendo-Achillis six lines above the tuber calcis. The Soleus is fleshy throughout and does not receive any slip of the Biceps Flexor.—The nerve supply of the Gastrocnemius is from the sciatic. The Soleus also is supplied by a branch of the sciatic, passing between the Plantaris and the external head.

Plantaris.—Fusing as it does with the outer head of the Gastrocnemius, the Plantaris can be traced with scarcely any artificial dissection to the Sesamoid bone in the outer head of the Gastrocnemius. The surface of contact between the Plantaris and the Gastrocnemius is fibrous throughout. This is seen to be different from the arrangement in *Felis*, in which animal the Plantaris arises in part from the fascia of the leg. The Plantaris tendon becomes superficial to the outer side of the tendo-Achillis, passes over the calcaneum as a broad aponeurosis, from the distal end of which, on the plantar surface of the foot, the Flexor Brevis Digitorum arises. The motion between the Plantaris and the Flexor Brevis Digitorum is pronounced medianly but absent laterally. The Plantaris may thus be said to be inserted into the calcaneum on its lateral surface, and the Flexor Brevis Digitorum to arise from the same surface. On the median aspect, however, the two muscles are continuous with one another through intermediate fibrous tissue. It is supplied by the sciatic nerve.

Popliteus arises from a shallow pit on the lateral surface of the external condyle by a ligament-like tendon, that passes in a groove horizontally backward to the tibia. The muscular fibres are arranged in a thin sheet and are inserted into the tibia for its upper third. The proximal edge of the muscle is horizontal and in the same line with the tendon of origin. The distal edge is oblique and slightly overlaps the fascia covering the Flexor Longus Pollicis. The nerve supply is from the sciatic.

Flexor Longus Digitorum arises from the proximal half of the posterior surface of the tibia, and from the stout fascia lying on the posterior aspect of the muscle. The very stout, broad tendon formed at the middle of the leg, lies in a groove behind the inter-

nal malleolus in company with the small Tibialis Posticus, and is inserted on the median side of the conjoined tendon at the tarso-metatarsal line. It receives all the fibres of the Musculus Accessorius.

Musculus Accessorius arises from the lateral aspect of the calcaneum, and is inserted on the median half of the conjoined tendon.

Flexor Longus Pollicis arises from the proximal two-thirds of the posterior surface of the shaft of the fibula, and by nearly as long a surface from the tibia. The fibres of the tendon can be traced nearly to the head of the fibula but become free only at the level of the ankle. The tendon lies in the deep recess between the tibia and the fibula, in the pronounced groove on the posterior border of the astragalus, as well as in the depression beneath the *sustentaculum tali* to unite with the conjoined tendon at its lateral half. The conjoined tendon splits into five phalangeal slips, one for each of the five toes—each tendon being inserted into the plantar tubercle of the terminal phalanx.

Lumbricales.—These are three in number and are supplied to the second, third and fourth toes. The muscle for the first toe arises from the tendon of the long flexor of the second, that for the second from the tendon of the third toe, and that for the third from the tendon of the fourth toe. These slips are inserted on the sheath of the flexor tendons, which cannot be separated from the tendon of insertion of the Extensor Longus Digitorum.

Tibialis Posticus arises from the proximal ends of both the tibia and the fibula. It passes downward parallel to and in part concealed by the Flexor Longus Digitorum, in company with the tendon of which it enters a sheath behind the internal malleolus. It is inserted into the scaphoid bone. The posterior tibial group of muscles receives its nerves from the internal popliteal nerve as it passes between the two heads of the Gastrocnemius.

Peroneus Longus arises tendinously from the lateral surface of the head of the fibula, by a head that is slightly narrower than the belly. It becomes tendinous at the middle third of the leg, thence passes through a separate sheath over the external malleolus, it lies in a groove on the calcaneum beneath the *sustentaculum tali* and is inserted into the base of the fifth metatarsal bone.

Peroneus Brevis arises broad and fleshy from the posterior

surface of the fibula at its middle third. Its muscular fibres pass down as far as the external malleolus with the tendon, which is twice as broad as that of the Peroneus Longus and is inserted into the base of the dorsal surface of the fifth metatarsal bone. A slip from the tendon just before the insertion is continuous with the dorsal aponeurosis lying beneath the Flexor Brevis Digitorum. Traction on this sheet slightly extends the toes, a function best seen along the lateral border of the foot.—The nerve-supply is by a branch of the anterior tibial which extends nearly the entire length of this muscle.

Peroneus Tertius arises at the proximal third of the fibula by oblique, delicate, fleshy fibres. The tendon lies in the same groove on the posterior aspect of the external malleolus with that of the Peroneus Brevis. It is inserted with the Extensor Brevis Digitorum at the base of the fifth metatarsal bone.

Tibialis Anticus arises from the outer tibial tuberosity and the tibial tubercle from the anterior tibial crest at its upper third, and from the fascia of the leg. The muscle becomes tendinous at the lower fourth of the shaft of the tibia, and is inserted into the base of the first metatarsal bone. In some subjects a slip arises separately from the interosseous membrane. The muscle receives its nerve-supply from the anterior tibial.

Extensor Longus Digitorum arises by a small narrow tendon from a pit on the external condyle of the femur above that for the Popliteus. The tendon passes downward parallel with the external lateral ligament, and beneath the fascial insertion of the Biceps Flexor Cruris, thence lying in a smooth groove between the head of the fibula and the outer tibial tuberosity it is continuous with the narrow thong of muscular fibre constituting the body of the muscle. The tendons of insertion are formed at the lower third of the tibia, and form a close bundle of rounded cords, that descend to the ankle, at which point they pass through a special loop of the annular ligament to be displayed in a tendon-centre as flat, mutually-supporting bands on the medio-dorsal aspect of the foot. From the distal border of this centre, flat tendons pass to the second and to the fifth toes. The muscle receives its nerves from the anterior tibial at the proximal end.

Extensor Brevis Digitorum arises from the outer surface of the calcaneum and the loop of annular ligament for the last-named muscle. A broad, tendinous expanse, aponeurotic in structure,

furnishes the short, broad tendons of insertion (lying beneath those of the long flexor) into the toes from the second to the fourth. It is joined by the Peroneus Tertius.

Extensor Longus Pollicis.—This was found in one subject only. It arises from the fibula at its upper third.

The intrinsic muscles of the pes embrace the following:—

Flexor Brevis Digitorum.—This flat, muscular sheet arises from the intersection between it and the Plantaris, as this structure underlies the calcaneum. (See the account of the Plantaris.) At the proximal half the muscle is uniformly fleshy. It splits into four slender fascicles. In some specimens the fascicle to the second toe is given off a little higher than the others at the distal half.

Opposite to the metatarso-phalangeal joints, from the second to the fifth, each of the four delicate tendons enters the sheath in common with the corresponding tendons of the Flexor Longus Digitorum and by splitting embraces the last-named tendons.

The ends of each split tendon are inserted on the second phalanx. Passing between the tendons of the short and the long flexors are three muscular slips. They arise from the plantar surface of the conjoined tendon. They are inserted respectively into the tendon of the first, second, and third toes.[1]

The Flexor Brevis Pollicis is represented by two distinct muscles each ending in a sesamoid. The Adductor Pollicis is inserted half way up the lateral border of the second phalanx. According to the terminology of human anatomy, the following would be the arrangement of the Dorsal and Plantar Interossei muscles:—

The first and second Dorsal Interossei are united at the middle by two stout fasciculi. The third Dorsal Interosseous unites with the first Palmar at the distal half of the third metatarsal bone. The fourth Dorsal Interosseous is similarly fused with the second Palmar Interosseous. The third Palmar Interosseous is absent. A small oblique muscle having relations to the second toe similar to those entertained by the Adductor Pollicis to the first, is inserted upon the first phalanx of the second toe.

[1] The arrangement of fibres passing from the short to the long flexor of the toes has received special attention from E. Schulze, (Zeitschr. für wissen. Zool., xvii, 1867, 1) who has figured them as they exist in the dog.

Studying these muscles without reference to human anatomy, the arrangement is simple, and the terminology herewith employed much preferable, in my judgment, to that in the foregoing section.

Five Metatarso-Phalangeal Flexors are present in the foot of the *Procyon*. The least differentiated of these is seen in the third muscle of the series. This muscle remains unspecialized as far as the proximal third of the third metatarsal bone. It then divides into two stout fasciculi, each of which goes to the sesamoid bone of its own side. *Procyon*, as *Felis*, possesses a pair of sesamoid bones to each metatarso-phalangeal joint.—The fourth Metatarso-Phalangeal Flexor is essentially the same in plan as is the third.—That of the second toe, however, exhibits almost complete longitudinal cleavage, two short oblique bands alone uniting the now almost distinct muscles. The lateral half of the muscle arises from the sheath of the Peroneus Longus muscle, the median half arising from the under surface of the first cuneiform in common with the lateral half of the first Metatarso-Phalangeal Flexor. The muscle last named is highly specialized, the two halves being distinct throughout, but for a small oblique fascicle at the proximal end of the two muscles, the median arising as above indicated and the lateral from a supernumerary ossicle lying on the plantar aspect of the third cuneiform bone.—The fifth Metatarso-Phalangeal Flexor is, like the first, highly specialized and composed of two non-communicating slips, both of which arise from a supernumerary ossicle in the sheath of the Peroneus Longus.

The median portion of the same sheath sends distally three radiated fasciculi. The median is homologous with the Adductor Pollicis, the remaining two are functionally adductors to the second and fifth toes respectively.

Opponens Pollicis.—Under this heading is appropriately included a stout muscular fasciculus passing from the under surface of the astragalus and inserted into the base of the first metatarsal bone.

According to the classification of the intrinsic muscles of the foot, proposed by D. L. Cunningham (Journ. Anat. and Physiol., xiii, 1879, 1), by which palmar adductors, dorsal adductors and intermediate flexors are identified, the muscles in *Procyon* exhibit well-developed palmar adductors and intermediate flexors, while the dorsal adductors are rudimentary or absent.

Concluding Remarks.—The tendency for certain muscles, as the Gluteus Medius, the Semimembranosus, the Biceps Cubiti, the Triceps, and the Masseter to undergo partial planal cleavage, *i. e.*, to form distinct laminæ at one part, while but a single lamina, embracing the entire thickness of the muscle, at another, indicates that such muscles are imperfectly differentiated, but are yet sufficiently differentiated to receive nerve-supply from separate sources.

In the process by which a muscle-sheet is changed into a muscle-thong or "cord" (premising such a process ever to take place), the sheet is folded once upon itself. The two halves of the sheet constitute the laminæ. The space between becomes the interlaminate space, and receives the nerves. This retention of a muscle-thong with the laminæ and interlaminate space as seen in many muscles of *Procyon* would indicate a lower type of muscle than any seen in *Felis*, in which genus the tendency exists for the interlaminate space to become obliterated by the fusion of the laminæ. The nerve, however, always enters the muscle at the position of the lines of fusion.

While the changes witnessed in a sheet of muscle undergoing longitudinal *cleavage* are included under the head of progressive development (as is witnessed in the evolution of special slips from the Panniculus Carnosus in the formation of the muscles of the auricle and of the face; and while similar changes are known to occur by which the great vertebro-costal masses send off partially distinct fascicles to various portions of the trunk), those witnessed in the limbs by which distinct laminæ in an early form undergo *fusion*, and thereby become complex in a later form, are to be included under the same general head. In that variety of development by which a single muscle is converted into many muscles by a process of splitting, the portions thereby formed can reunite by a process of splicing. The splitting is carried as far in *Felis* as in *Procyon*, but the splicing process is carried farther in *Felis*.

The number of nerves was found to be subject to considerable variation. Muscles of low degree of specialization such as the Latissimus Dorsi, Biceps Flexor and Semimembranosus were found richer in nerves than highly specialized muscles such as the Tibialis Anticus and the Supinator Longus. Between *Felis* and *Procyon* marked contrasts were presented between muscles of the same name—the lowly specialized muscles in all instances

receiving more nerves in *Procyon* than in *Felis*. The number of nerves diminish as a laminated muscle in *Procyon* becomes highly fused in *Felis*. This was well exhibited in the instance of the Biceps Cubiti.

Under the head of muscle-variations it has been seen that many muscles in *Procyon* correspond to abnormal muscles in man. Some of these have been noted in the text. It is equally instructive to note many that are identical with the human muscles, such, for example, as the rotators of the femur. Other muscles in *Procyon* appear to be beyond the limits of variation of human myology. Among the latter group may be named the continuity of the Plantaris and the Flexor Brevis Digitorum, the accession from the Panniculus to the Pectoralis, and the fusion between the Flexor Longus Pollicis Pedis and the Flexor Longus Digitorum Pedis.

May 23.

The President, Dr. Leidy, in the chair.

Forty-four persons present.

On Bacillus anthracis.—Prof. Leidy stated that Dr. Robert Gladfelter, veterinary surgeon, had submitted to his examination a bottle of blood from a cow. The animal, apparently well on Wednesday, May 10th, and milked the same evening, died the next morning. The cause was not clear but was suspected to be the result of anthrax, charbon, or splenic fever. During the past year a number of cows in the same herd, had died in a similar manner, in Salem Co., N. J. A post-mortem examination was made the following day; and the abdominal viscera were found much conjested; especially the spleen, which was gorged with blood. The specimen of blood, obtained from the spleen was examined the next day, Friday. It teemed with Bacteria, the peculiar form, *Bacillus anthracis*, which is now viewed by most competent authorities as the cause of the frightful affection known as anthrax or splenic fever. The Bacilli were actually more numerous than the blood corpuscles, which appeared unchanged. The Bacilli were completely motionless; straight, bent or zigzag filaments, in the latter condition in pairs or more segments. They measured from 0.006 to 0.042 mm. in length; usually from 0.012 to 0.03 mm. Kept for some days in the blood the filaments underwent division into little chains in two, three, or more dumb-bells, which measure about 0.005 mm., or into isolated micrococci-like particles about 0.0015 mm. Many however of the filaments did not resolve themselves into these minute particles, but appeared only to grow in length and divide into segments of about 0.012 mm. in length.

On Enchytræus, Distichopus and their parasites.—Prof. Leidy remarked that occasionally in lifting a flower-pot or in stirring the earth within, attention is sometimes attracted by the sudden wriggling of a little white worm disturbed from its rest. In the Archiv für Anatomie, 1837, Henle has given an elaborate description of the worm and named it *Enchytræus* in reference to its familliar habitation. The little pot worm is common in our vicinity, especially in damp forests under decaying leaves and timber. It was first noticed in 1773 from Denmark by O. F. Müller, and in 1880 from Greenland by Fabricius. It has also been observed in France and Germany; and therefore the little worm appears to extend over the northern parts of Europe and America.

The same worm I have found in the meadows of Atlantic City, New Jersey, in the usual haunts of *Melampus bidentatus* and *Orchestia agilis*. In mature specimens, about three-fourths of an inch in length, the girdle is well produced, and the body has ten setigerous segments in advance of it and about forty-five behind it. The short pointed setapeds in four longitudinal rows, are in fascicles of three or four to each, in advance of the girdle and two or three to each behind it.

In the Enchytræus of our forests I have repeatedly observed an infusorial parasite, occupying the body cavity, sometimes in considerable numbers, mingled with the normal discoid corpuscles. I propose to name it *Anoplophrya modesta*. In the Enchytræus of the meadows of Atlantic City I observed a different infusorian, occupying the same cavity, remarkable for its great proportionate length. This I propose to name *Anoplophrya funiculus*.

Wishing to ascertain whether the latter did not likewise infest the Enchytræus of our neighboring forests I recently collected a number of little worms at Media, Del., Co., These I obtained from beneath a stone lying in my path to Swarthmore College. They appeared to be robust specimens of *Enchytræus vermicularis*, for which I took them to be. Investigation at home proved them to be different and generically distinct from previous known forms. The worms possess but two rows of setapeds, instead of four as in most others of the family. Hoffmeister and Gruby described the genus *Phreoryctes* as having only two rows of setapeds, but Leydig has shown this to be an error. In view of the error I carefully repeated my examination of the little worms from Media, and am convinced that they possess two rows of setapeds, while in *Enchytræus* I always found four. So much do the former otherwise resemble the latter that it would appear as if they formed a genus directly evolved from *Enchytræus* merely by the suppression of a pair of the four rows of setapeds.

The new genus presents the following characters and may be indicated by the accompanying name.

DISTICHOPUS. Form and color as in *Enchytræus;* with a well produced girdle. Setapeds in a single row on each side ventrally, in divergent fascicles of four in advance of the girdle and of three behind it.

DISTICHOPUS SILVESTRIS. Body cylindrical, white, translucent, with a well produced girdle of whiter color. Upper lip short conical blunt; anal segment thicker than the penultimate, brownish and punctate; anus quinquiradiate. Ten setigerous segments in advance of the girdle, with fascicles of usually three or four setapeds; fifty-five setigerous segments behind the girdle, with usually two or three setapeds. Oral and anal segments without setapeds. Setapeds shorter and stouter than in *Enchytræus vermicularis*, curved at the root, swollen at the middle, and straight towards the point. Length from nine to fifteen lines.

I observed no infusorian in *Distichopus*, but in most of those examined there were found within the intestine minute Gregarines

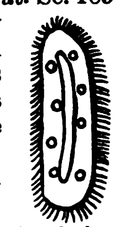
allied to the *Monocystis* of the earth worms, *Lumbricus*. This parasite was perfectly quiescent and was especially remarkable from its frequently containing a variable number of curved elliptical bodies, which I suspect to be spores. Viewing it as a species of *Monocystis* it may thus be briefly characterized.

MONOCYSTIS MITIS. *Gregarina Enchytræi?* Kölliker. Body fusiform, tapering posteriorly and usually acute, anteriorly obtuse or produced into a short mammilla; contents of the usual granular protoplasm as in gregarines, with a central spherical nucleus and nucleolus. Size ranging from .03 mm. to .12 mm. in length. In the smallest individuals the nucleus was indistinct and in some appeared to be absent. The larger ones mostly contained what I supposed to be spores. These are curved elliptical bodies .015 mm. long by .0045 mm. wide, and were collected in a group of usually two or three to seven or eight, sometimes in advance of the nucleus, and sometimes behind it.

Monocystis mitis, 333 diam.

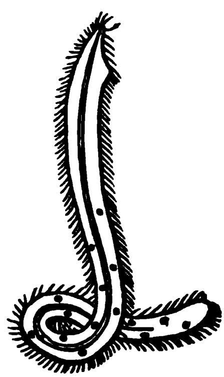
The two Anoplophrya above indicated have the following characters.

ANOPLOPHRYA MODESTA. *Leucophrys*. Jour. Ac. Nat. Sc. 1850, 49, pl. 2, fig. 17. Elongated elliptical, anteriorly rounded, posteriorly somewhat truncated, usually from three to five times the length of the breath; nucleus axial, cylindrical, straight, extending about two-thirds the length of the body; contractile vesicles variable in number and usually in two longitudinal rows. Length from .048 to .12 mm.; breadth .018 to .024 mm. In state of transverse division, the pairs range from .054 to .15 mm. in length. Common and numerous in the body cavity of *Enchytræus vermicularis*.



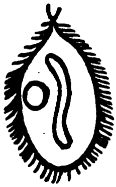
Anoplophrya modesta, 350 diam.

ANOPLOPHRYA FUNICULUS. Long, narrow and ulna-like in shape, from twenty to thirty times the length of the breadth; anterior extremity slightly wider and very obliquely truncated and slightly depressed; posterior extremity bluntly rounded. Nucleus axial, bristle-like, appearing as a double continued line reaching from the posterior end of the body and tapering to a single line in the posterior part of the same. Contractile vesicles minute, in two rows, variable in size and usually occupying the posterior part of the body. Length 0.42 mm. to 0.6 mm. by 0.018 to 0.024 mm. wide. Young individuals 0.15 mm. long by 0.024 wide, were tapering in front and obtuse while they were wider and rounded behind. Inhabiting the body cavity of *Enchytræus vermicularis* from the meadows of the Atlantic coast of New Jersey.



A. funiculus, 175 diam.

In an earth worm, *Lumbricus*, species undetermined and occurring under logs, in the forests in the vicinity of Philadelphia, I detected another species of the above which may be distinguished as follows.



A. melo, 250 diam.

ANOPLOPHYRA MELO. Oval or ovoid, scarcely twice the length of the breadth, with the narrower pole mucronate; nucleus axial, cylindrical, sigmoid, about two-thirds the length of the body; contractile vesicles usually one, or two, or none, large. Length 0.048 mm. to 0.08 mm., breadth 0.032 to 0.04 mm. Pairs in state of transverse division 0.08 by 0.036 mm. to 0.084 by 0.04 mm. Inhabiting the body cavity of *Lumbricus*?

The Rev. Henry C. McCook, D.D., was elected Vice-President and Jacob Binder was elected Curator to fill vacancies caused by the death of Wm. S. Vaux.

Thomas A. Robinson was elected a member of the Council, to fill the vacancy caused by the election of the Rev. Dr. McCook to the Vice-Presidency.

MAY 30.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

The Yellow Ant with its flocks of Aphis and Coccus.—Prof. LEIDY stated that since he had made a communication, published in the Proceedings of April 10th, 1877, on the habits of the Yellow Ant, from time to time, in seeking for other animals, he had incidentally learned that the species is not only a common one of our vicinity, but also that it was habitual with the ant to care for the same two species of *Aphis* and *Coccus* originally noticed in company with it. The ant workers, of the species *Lasius interjectus*, are of a uniform bright amber color, shining and hairy, and measure about 3½ millemetres long.[1] The Aphis is white or pale yellowish and covered with a white waxy secretion, has brownish legs and proboscis, no honey tubes, and is about 2½ mm. long and 2 mm. wide. The Coccus is red with some whitish waxy secretion and is from three-fourths to one millemetre and one-half in length.

On the third of May, near Swarthmore College, Del. Co., a nest of the yellow ants was observed beneath a flat stone, about one

[1]In the original communication the ant was named *Formica flava*, but the Rev. Dr. McCook has determined it to be as here stated.

foot by seven inches broad. Collected on the under side of the stone there were six distinct and closely crowded groups of the white aphis and five of the red coccus. The largest aphis group was three inches by one inch; the smallest one-half inch in diameter. The largest coccus group was an inch and one-half by three-fourths of an inch, and the smallest one-half an inch by one-fourth of an inch. The ground beneath the stone was furrowed by tortuous paths communicating with holes, through which ants were running; but most of these together with their flocks were adherent to the under side of the stone, and occupied a space of about six inches by four inches.

Colorless Garnet and Tourmaline.—Prof. LEIDY further exhibited several brilliant cut specimens of garnet, from Hull, Quebec, Canada. They are transparent, with a pale yellowish tint like an off-colored diamond, and are flawless. Another specimen was a handsome colorless brilliant of achroite or tourmaline from St. Lawrence Co., New York.

JUNE 6.

The President, Dr. LEIDY, in the chair.

Thirty-three persons present.

A paper entitled "On the relative Ages and Classification of the Post-Eocene Tertiary Deposits of the Atlantic Slope," by Angelo Heilprin, was presented for publication.

The deaths of Wm. B. Rogers, a Correspondent, and Samuel P. Carpenter and Andrew C. Craig, members, were announced.

JUNE 13.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-nine persons present.

The following was ordered to be printed:—

ON THE RELATIVE AGES AND CLASSIFICATION OF THE POST-EOCENE TERTIARY DEPOSITS OF THE ATLANTIC SLOPE.

BY ANGELO HEILPRIN.

It may appear surprising that for a period of nearly fifty years after the study of the American tertiary formations was first systematically attempted, there should still have existed among geologists widely varying views, not only relative to the positions occupied by a considerable proportion of the deposits in question in the geological scale, but also relative to the positions occupied by these deposits in respect of each other. Yet such has been the case, and it may still be said to be the case at the present time. The existence of post-eocene deposits along the Atlantic border of the United States has long since been recognized, and their contained fossil remains investigated and delineated by paleontologists of more or less ability. While the opinions expressed by certain geologists as to the age of at least some of these deposits may be said to have been substantially correct, yet in face of the conflicting views of other geologists of no less experience and prominence, which were set forth and maintained with a decisiveness unwarranted by the character of the research upon which they were based, it may be stated that the general outcome of our knowledge respecting the stratigraphy of the deposits here referred to is simply, that they hold a position somewhere intermediate between the eocene and the post-pliocene series.

The post-eocene tertiary deposits have their greatest development, and have been most carefully investigated in the States of Maryland, Virginia, North and South Carolina. In the frequently expressed opinion of Mr. Conrad they represented over the entire area here indicated one geological formation, which that geologist generally asserted to be the miocene, but which, at the same time, he not unfrequently considered to be the equivalent of the British crag, a formation now universally regarded as being of pliocene age.

No attempt appears to have been made to determine whether the deposits were referable to one or several faunal horizons, and the organic remains obtained from them were simply classified as belonging to the miocene or "medial tertiary" period. The circumstance that in North Carolina the proportion of recent to

extinct forms among the imbedded remains was greater than in either Virginia or Maryland did not escape the notice of the observer mentioned, but yet he did not hesitate to conclude (Kerr, Geological Survey of North Carolina, Appendix, p. 25, 1875) that his miocene strata represented " one contemporaneous sea bottom, holding living individuals of certain species throughout its entire length, and which is characterized by some of its species closely resembling existing ones, but many more having no affinity with American shells." How many of the fossil species were by Mr. Conrad considered to be identical with recent forms, it is impossible to determine with any amount of exactitude, since the opinions of that geologist bearing upon this point appear not to have been fixed and to have fluctuated extensively within very brief intervals of time. Thus, while in 1838 (Fossils of the Medial Tertiary Formations, Introduction, p. xvi), it is asserted that of about 200 described species 19 (or less than 10 per cent.) are still among the living fauna, in 1843 (Proc. Phil. Acad. Nat. Sciences, i, p. 328), the number of recent forms is said to be 43 out of a total of 328 described; in 1862, on the other hand, referring to the South Carolina deposits, where the percentage of recent forms had been claimed to be greater than in either of the other three states, Mr. Conrad maintains that "it may be that all the species are extinct" (Proc. Acad. Nat. Sciences, xiv, p. 559). It is further stated (*loc. cit.*) that of the entire number, 581, of miocene shells of the Atlantic stope, the number of forms that could be considered as doubtfully identical with recent species was not more than 30 (or about 5 per cent). The faunal relations existing between these so-called "medial tertiary" deposits and the deposits of the British crag and the faluns of the Loire, at that time supposed to be of nearly equivalent age, were likewise pointed out by Lyell (Journ. Geol. Society, i, pp. 413 *et. seq.*), who also did not fail to notice that in North Carolina "the recent species bore a larger proportion than usual to the extinct" (*loc. cit.*, p. 418). But this geologist, with his characteristic acuteness, further remarks: "As, however, it would be very rash to assume that all the miocene deposits of the United States, especially in countries as far apart as Maryland and South Carolina, were of strictly contemporaneous origin, the fossil faunas of each region should be carefully distinguished and considered separately" (p. 418). Of 147 species of mollusca gathered by Mr. Lyell himself, and which

were subsequently studied with the assistance of Mr. Sowerby, twenty-three (or 15½ per cent.) were considered to be identical with recent forms (p. 419). In the later editions of the "Elements of Geology" (1871, 1874) the deposits in question are referred to the pliocene and miocene, but no clearly defined statement is given as to which belonged to the one age, and which to the other.

From a more careful examination of the South Carolina region than had previously been made, Mr. Tuomey arrived at the conclusion (Geology of South Carolina, 1848), that the post-eocene tertiary deposits of that State belonged to the pliocene, and not to the miocene period, and that, consequently, they were not contemporaneous with the deposits (in Virginia) which had now been firmly recognized as typically representing the miocene of the eastern United States. Of about 170 species of mollusca contained by them, somewhat more than 80 (or nearly 50 per cent.), were considered to be still living along the Atlantic and Gulf coasts (*op. cit.*, pp. 206–208). The pliocene age of these deposits was maintained by Professors Tuomey and Holmes in their "Pleiocene Fossils of South Carolina" (1857), where, also, the deposits of North Carolina (miocene of Emmons, North Carolina Geological Survey, 1858), are referred to the same period. Of 203 species of described invertebrate remains (mollusks, echinoderms, and corals), 85 (or 42 per cent.) were considered to have living analogues (*op. cit.*, Introduction, IX.) The determinations of Tuomey and Holmes for both the South and North Carolina deposits are accepted by Dana for the several editions (1863, 1875, 1880) of his "Manual of Geology," where the "Yorktown" period is made to include the post-eocene tertiary beds of Virginia, Maryland, New Jersey, and Martha's Vineyard, and the "Sumter" period, the similar beds of North and South Carolina. In the "Check List of the Invertebrate Fossils of North America," prepared (doubtless from data furnished by Conrad) in 1864 by Mr. Meek, for the Smithsonian Institution (Miscellaneous Collections, VII.), all the non-eocene or oligocene tertiary fossils of the eastern United States are classed as belonging to the miocene period; and finally, Prof. C. H. Hitchcock, in the "Geological Map of the United States" (1881), accepts the miocene determination for the age of the North and South Carolina deposits, as likewise for the Virginia deposits, and those of the peninsula of Maryland. The deposits of the Maryland east-

shore, of Delaware, and the greater portion of those in New Jersey which lie to the east and south of the "upper marl bed," and whose age has not yet been satisfactorily made out, are embraced within the pliocene (newer tertiary).

In order to facilitate the solution of the stratigraphical problem herein involved, the following faunal lists of the several States (Maryland, Virginia, North and South Carolina) have been prepared, and comparisons between them instituted. The utterly desultory and careless manner in which a very considerable portion of the paleontology of the region referred to has been worked up, has rendered their preparation a matter of great difficulty, and, indeed, if absolute accuracy is concerned, a well nigh impossibility. Not only have species been referred to several distinct genera (and families), and catalogued under their respective generic names independently of each other, but in several instances the identical specimen has been figured and redescribed under two or more forms; species, again, originally described from the deposits of one State, have been subsequently credited (and to the exclusion of the first-named locality) to the deposits of another State. Defective illustrations, and in very many cases the absence of illustrations altogether, have still further increased the difficulties, especially where the described specimens themselves are wanting, or where through an unsatisfactory diagnosis their specific (or even generic!) identification is rendered hopeless. Many of the forms here included are therefore taken on faith, and many will doubtless have to be excluded when fresh material is gathered in the field and re-studied. *Per contra*, many forms, seemingly doubtful, have been excluded, which may possibly have to be reinstated on further examination. Where it has been possible (and this has been the case for most of the forms) the original descriptions of the species have been referred to, and the localities of their occurrence there indicated have been those which have been noted; species said to occur in the deposits of several States have been traced back for re-descriptions, or to papers bearing specially on the paleontology of those States, but very little reliance being placed on general enumerations of distribution. By this means it has been hoped to render the lists as complete and free from error as could reasonably be made possible, and while, doubtless, various modifications will eventually have to be introduced, it is

confidently believed by the author that they so far represent the true state of matters as to permit of positive conclusions being drawn from them.

The comparisons here instituted between the molluscan faunas from the deposits of the several States have been made separately for the lamellibranchiata and the gasteropoda; and it may be stated at the outset that the results obtained from the independent examination of these two groups of organisms have been found singularly confirmative of each other. The letters following the name of a species denote that the form is also found in the State or States indicated by their respective characters; but it must be noted in the case of the gasteropoda, that comparisons, as indicated by such initial characters, are made between certain States only, and, therefore, it is not to be concluded from the examination of a single list, that a given form there designated is necessarily wanting in a State whose characters are not indicated in that list. Thus, in the South Carolina list only the North Carolina species are specially indicated, although several of these last, and others, are also found in the Virginia and Maryland deposits; so, again, in the Virginia list, no special reference is made to the Maryland forms.

TABLES OF THE POST-EOCENE TERTIARY LAMELLIBRANCHIATA OF SOUTH CAROLINA AND NORTH CAROLINA.

SOUTH CAROLINA.

Pectunculus passus, N. C.; Va.
" quinquerugatus, N. C.
" lævis,
" aratus, N. C.
" transversus,
Yoldia limatula, N. C.; Va.; M.
Leda acuta, N. C.; M.
Nucula proxima,
= N. obliqua, N. C.; Va.; M.
Lucina contracta,
= L. filosa, N. C.; Va.; M.
anodonta, N. C.; Va.; M.
Pennsylvanica, N. C.
radians,
= L. Antillarum, N. C.
squamosa,
= L. pecten, N. C.; Va.
cribraria, M.
divaricata, N. C.; Va.; M.
costata,
crenulata, N. C.; Va.; M.
multilineata, N. C.
trisulcata,
Cardium Carolinense,
= C. magnum? N. C.
" muricatum, N. C.
" sublineatum, N. C.; Va.
Cardita arata, N C.; Va.; M.
" granulata, N. C.; Va.; M.
" tridentata, N. C.?
" carinata, N. C.
" perplana, N. C.
" abbreviata, N. C.
Astarte undulata, N. C.; Va.; M.
" bella, N. C.
Gouldia lunulata, N. C.; Va.
Crassatella undulata, N. C.; Va.; M.
" Gibbesii, N. C.
Cyrena densata, N. C.; Va.
Rangia clathrodonta, N. C.; Va.
Venus Rileyi, N. C.; M.
Venus mercenaria, N. C; Va.?; M.?
" athleta, N. C.
" tridacnoides, N. C.; Va.; M.
" fermagna, Va.; M.?
Cytherea subnasuta, M.
" reposta, N. C.; Va.
" Sayana, N. C.; Va.; M.
" cribraria, N. C.
= C. punctulata?
" cancellata,
Circe metastria, N. C.; Va.
Artemis intermedia, N. C.
Petricola pholadiformis,
Tellina biplicata, N. C.; M.
" alternata, N. C.
" lusoria, N. C.; Va.
" polita, N. C.
Strigilla flexuosa, N. C.
Psammocola Pleiocena,
Cumingia tellinoides, Va.
Amphidesma carinata, M.
" equalis, N. C.
" orbiculata,
" æquata, N. C.
Donax variabilis, N. C.?
Standella fragilis, N. C.?
Mactra similis, N. C.
= M. solidissima,
" lateralis, N. C.
" congesta, N. C.; Va.;
Pandora trilineata, N. C.? Va.
Panopæa reflexa, N. C.; Va.; M.
Corbula cuneata, N. C.; M.
" inequale, Va.; M.
Pholadomya abrupta, N.C.; Va.; M.
Solecurtus Caribæus, N. C.
Solen ensis, N. C.; M.
Pholas costata, N. C.; Va.? M.?
" oblongata, N. C.
" Memmingeri, N. C.

North Carolina.

Anomia ephippium, S. C.
Ostrea Virginianá, S. C.; Va.; M.
Pecten comparilis, S. C.
Pecten eboreus, S. C.; Va.
" Clintonius, Va.; M.
= P. Magellanicus.

Pecten Peedeensis, S. C.
" Mortoni, S. C.
" Jeffersonius, Va.; M.
" Madisonius, Va.; M.
" vicenarius.
Plicatula marginata, S. C.; Va.; M.
Mytilus incrassatus, S. C.
Crenella, sp.?
Chama arcinella, S. C.
" corticosa, S. C.; Va.
" congregata, S. C.; Va.
" striata.
Arca lienosa, S. C.
= A. Floridana.
" limula, Va.
" scalaris, S. C.; Va.
" incile, S. C.; Va.; M.
" centenaria, S. C.; Va.; M.
" cælata, S. C.
" idonea, Va.; M.
" plicatura, S. C.; M.; Va.
" brevidesma.
" subsinuata.
Pectunculus subovatus, S. C.; Va.; M.
" lentiformis, S. C.; Va.; M.
" aratus, S. C.
" tricenarius.

Loripes elevata.
Mysia Americana (acclinis).
Cardium Carolinense, S. C.
= C. magnum?
" muricatum, S. C.
" sublineatum, S. C.; Va.
Glycocardia granula.
Isocardia fracterna, Va.; M.
Cardita arata, S. C.; Va.; M.
" perplana, S. C.
" granulata, S. C.; Va.; M.
" abbreviata, S. C.
" tridentata, S. C.
" carinata, S. C.
Pleuromeris decemcostata.
Astarte bella, S. C.
" clathra.
" undulata, S. C.; Va.; M.
" curta.
Gouldia lunulata, S. C.; Va.
Crassatella undulata, S. C.; Va.; M.
" Gibbsii, S. C.
" Marylandica. M.
" melina, Va.; M.
Verticordia, sp.?
Cyrena densata, S. C.; Va.
Rangia clathrodonta, S. C.; Va.
Venus mercenaria, S. C.; Va.? M.?

[redacted]

Strigilla flexuosa,	S. C.
Amphidesma æquata,	S. C.
" equalis,	S. C.
Mulinia variabilis.	
Mactra congesta,	S. C.; Va.
" oblongata,	S. C.?
= Standella fragilis?	
" lateralis,	S. C.
" similis,	S. C.
= M. solidissima.	
Donax, sp.?	
Pandora trilineata?	S. C.; Va.
Panopæa reflexa,	S. C.; Va.; M.
Corbula cuneata,	S. C.; M.
Pholadomya abrupta,	S. C.; Va.; M.
Solecurtus Caribæus,	S. C.
Solen ensis,	S. C.; M.
Pholas costata,	S. C.; Va.? M.?
" oblongata,	S. C.
" Memmingeri,	S. C.

An examination of the preceding lists shows that of about 103 forms of lamellibranchiate mollusks found in the South Carolina deposits no less than 74–78 (or about 74 per cent.) are also found in the deposits of North Carolina; these last being represented by an almost equal number (106) of specific forms, the relative percentages of those common to the two States will necessarily be nearly identical. We have thus *prima facie* evidence that the deposits characterized by these remains belong very nearly, if not absolutely, to the same geological horizon. On the other hand, of the South Carolina forms at most only 43 (or 42 per cent.) are indicated as being found in Virginia, and a still smaller number, 34 (or 33 per cent.) in Maryland. We have here, therefore, strong evidence tending to prove that the deposits of the last mentioned States represent a horizon different from those indicated by the deposits of South Carolina. Similarly, of the 106 North Carolina species, at most only 48 (or 46 per cent.) are common to Virginia, and 36 (or 34 per cent.) to Maryland, a result that strikingly confirms the conclusion that has just been drawn.

Passing now to the examination of the Virginia lamellibranchiates, we find, as is shown in the following table, a total of about 109 specific forms :

VIRGINIA.

Anomia Ruffini.	
Ostrea sculpturata.	
" disparilis.	
" Virginiana,	S. C.; N. C.; M.
" subfalcata.	
Pecten fraternus.	
" Rogersi.	
" biformis.	
Pecten Virginianus.	
" tricenarius.	
" Jeffersonius,	N. C.; M.
" dispalatus.	
" septemnarius,	S. C.; M.
" Clintonius,	N. C.; M.
= P. Magellanicus.	
" eboreus,	S. C.; N. C.

Pecten Madisonius, N. C.; M.
" decemnarius.
Plicatula marginata,
S. C.; N. C.; M.
Perna maxillata, M.
Crenella æquilatera.
Arca centenaria, S. C.; N. C; M.
" incile, S. C.; N. C.; M.
" idonea, N. C.; M.
" protracta, S. C.? N. C.?
= A. lienosa?
" scalaris, S. C.; N. C.
" propatula (hians) S. C.
" limula, N. C.
" plicatura, S. C.; N. C; M.
Pectunculus subovatus,
S. C.; N. C.; M.
" tumulus.
" passus, S. C.; N. C.
" lentiformis,
S. C.; N. C.; M.
Yoldia limatula, S. C.; N. C.; M.
Nucula obliqua, S. C.; N. C.; M.
(N. proxima).
Lucina squamosa, S. C.; N. C.
= L. pecten.
" crenulata, S. C.; N. C.; M.
" divaricata, S. C.; N. C.; M.
" anodonta, S. C.; N. C.; M.
" contracta, S. C.; N. C.; M.

Astarte (Euloxa) latisulcata.
" arata
" Coheni.
" concentrica.
" lineolata.
" symmetrica.
Gouldia lunulata, S. C.; N. C.
Crassatella undulata,
S. C.; N. C.; M.
" melina, N. C.; M.
Cyrena densata, S. C.; N. C.
Rangia clathrodonta S. C.; N. C.
Venus capax.
" ascia?
" latilirata. N. C.
" mercenaria? S. C.; M.?
" permagna, S. C.; M.?
" alveata, N. C.; M.
" Rileyi, S. C.; N. C.; M.
" tridacnoides,
S. C.; N. C.; M.
Circe metastria, S. C.; N. C.
Cytherea obovata.
" reposta, S. C.; N. C.
" Sayana, S. C.; N. C.; M.
" densata.
" Virginica.
" cortinaria.
Artemis acetabulum, N. C.; M.
Petricola centenaria, M.

[redacted]

Poromya subovata.
Corbula inequale, S. C.; M.
Pholadomya abrupta, S. C.; N. C.; M.
Panopæa reflexa, S. C.; N. C.; M.
Solen magnodentatus ?
Saxicava bilineata, M.
= S. rugosa.
Saxicava pectorosa.
Pholas (?) rhomboidea.
" acuminata, S. C.? N. C.? M.?
= P. costata ?
Teredo fistula.
Gastrochæna ligula.

NOTE.—The following species described by H. C. Lea (Trans. Amer. Philos. Soc. IX, new series), based upon young shells, or upon such as barely admit of characterization, have been omitted from the enumeration: *Avicula multangula*, *Anatina tellinoides*, *Cytherea elevata*, *C. spherica*, *Leda acutidens*, *L. carinata*, *Modiola spinigera*, *Mya reflexa*, *Nucula dolabella*, *N. diaphana*, *Panopea dubia*, *Petricola compressa*, *Pecten micropleura*, *P. tenuis*, *Plicatula rudis*, *Psammobia lucinoides*, *Teredo calamus*.

Of these 109 species, as has already been stated, at most only 43 (or 40 per cent.) are common to South Carolina, and about 48 (or 44 per cent.) to North Carolina. Compared with the Maryland deposits the proportion of forms common to the two states is found to be not very different from the proportions just indicated, or about 38 per cent. (about 41 species).[1]

From the so-called "medial tertiary" of Maryland there have thus far been described about 98 species of acephalous mollusks:—

MARYLAND.—NEWER GROUP.

Amphidesma carinata, S. C.
" subovata,
Arca idonea, N. C.; Va.
" incile, S. C.; Va.
" centenaria, S. C.; Va.
" improcera, S. C.; N. C.; Va.
Artemis acetabulum, N. C.; Va.
Astarte vicina ?
" cuneiformis,
" perplana,
" obruta,
" undulata, S. C.; N. C.; Va.
Cardita arata, S. C.; N. C.; Va.
" protracta,
" granulata, S. C.; N. C.; Va.
Cardium laqueatum, Va.
Corbula cuneata, S. C.; N. C.;
" idonea
" inequalis, S. C.; Va.
Crassatella Marylandica, N. C.
" undulata, S. C.; N. C.; Va.
Cytherea Sayana, S. C.; N. C.; Va.
" albaria,
" Marylandica,
" staminea,
Isocardia fraterna, N. C.; Va.
Leda acuta, S. C.; N. C.
" concentrica,
Yoldia lævis, S. C.; N. C.; Va.
= Y. limatula,

[1] The Maryland deposits, in the comparisons thus far, have for convenience been taken to represent one geological horizon; their division into two groups, and the relations of each of these groups with the deposits of the several other States, are specially considered further on.

Nucula proxima, S. C.; N. C.; Va.
= N. obliqua,
Lepton (?) mactroides,
Lucina anodonta, S. C.; N. C.; Va.
" subobliqua,
" cribraria, S. C.
" contracta, S. C.; N. C.; Va.
= L. filosa,
" divaricata, S. C.; N. C.; Va.
Mactra ponderosa,
" fragosa,
" subcuneata,
" delumbis, Va.
Mya producta, Va.
Ostrea Virginica, S. C.; N. C.; Va.
Panopæa Americana,
" reflexa, S. C.; N. C.; Va.
" porrecta,
Pecten Madisonius, N. C.; Va.
" Jeffersonius, N. C.; Va.
" Clintonius, N. C.; Va.
" septemnarius, S. C.; Va.
Pectunculus subovatus,
S. C.; N. C.; Va.
Petricola centenaria, Va.
Plicatula marginata,
S. C.; N. C.; Va.
Pholadomya abrupta,
S. C.; N. C.; Va.
Pholas ovalis. S. C.? N. C.? Va.?
= P. costata?
Saxicava rugosa, Va.
Solen ensis, S. C.; N. C.
Tellina æquistriata,
" biplicata, S. C.; N. C.
Venus tetrica,
" permagna? S. C.; Va.
" alveata, N. C.; Va.
" inoceriformis,
" tridacnoides, S.C.; N.C.; Va.
" mercenaria? S.C.; N.C.; Va.?
" Rileyi, S. C.; N. C.; Va.
" cuneata.

Maryland.—Older Group.

Arca callipleura,
" subrostrata,
" Marylandica,
" triquetra,
Lucina subplana,
" crenulata, S. C.; N. C.; Va.
Modiola Ducatellii,
Mytilus incurva,
[redacted]

Of these 98 about 34 (35 per cent.) are common to South Carolina, 36 to North Carolina (37 per cent.), and 41 to Virginia (42 per cent.). It has, however, been shown in a previous paper (Heilprin, Proc. Acad. Nat. Sciences, 1880, pp. 20, *et. seq.*) that the Maryland deposits actually represent two distinct horizons—respectively designated (temporarily) as the "newer" and "older" groups—and, therefore, in order to have a proper appreciation of the value of these proportions it will be necessary to consider the two divisions in their relations to the several States separately.

The deposits of the "newer" group, as will be seen from the preceding enumeration, contain 66 species, and those of the "older" group, 32 species. Of the former about 33 (50 per cent.), and a nearly equal number, 32 (49 per cent.), are common respectively to South and North Carolina, whereas of the latter, only 4 (13 per cent.) are found in the first named State, and 7 (22 per cent.), in the second.[1] While the "newer" group shows a considerably higher percentage of forms common to both South and North Carolina than the deposits of the State treated as a whole, this percentage is still less than that which might naturally be expected to exist between formations (removed by about equal distances) representing an equivalent age. The rational inference is, therefore, that the deposits in question are not of contemporaneous formation. Compared with the deposits of Virginia the fauna of the "newer" group shows a somewhat more decided relation than to the deposits of the States just mentioned, for we now find the percentage of common forms increased to 56 (37 species). But even with this figure it would be rash to insist upon an equivalency being proved. Nor is the relation of the "older" group to the Virginian formation much more pronounced than it is to the North Carolinian, but no special deductions from agreements or differences of percentages can be made in this instance, since the number of both common and restricted forms is very limited.

The conclusions reached from the examination thus far of the lamellibranchiate fauna are: That the South and North Carolina formations represent one and the same horizon, and one distinct from the horizon or horizons indicated by the Virginia and Maryland formations. It now remains to be determined what

[1] These proportions strikingly corroborate the author's original assumption of two distinct horizons, based upon an examination of Maryland fossils alone.

support this conclusion receives from the study of the faunas in their relation to the faunas of existing seas, ascertain through the same means what relation the horizons bear toward each other.

SPECIES STILL LIVING FOUND FOSSIL IN THE SOUTH CARO DEPOSITS.[1]

Anomia ephippium (A. Conradi).
? Placunomia plicata.
Ostrea Virginiana.
Chama arcinella.
Arca lienosa = A. Floridana.
" incongrua.
? " pexata.
Yoldia limatula (Leda lævis).
Leda acuta.
Nucula proxima = N. obliqua.
Lucina contracta = L. filosa.
" Pennsylvanica.
" radians = L. Antillarum.
" squamosa (L. speciosa) = L. pecten.
" divaricata (L. Conradi).
" crenulata.
? Cardium Carolinense C. magnum ?
" muricatum.
? Cardita tridentata.
Gouldia lunulata.
Pandora trilineata.
Venus mercenaria.
? Cytherea cribraria - C. punctulata ?
Cytherea cancellata (C. cingenda).
Petricola pholadiformis.
Tellina alternata.
" polita.
" lusoria.
Strigilla flexuosa.
Cumingia tellinoides.
Amphidesma (Abra) equalis.
" (Semele) orbiculata.
? Donax variabilis.
Standella fragilis (Mactra oblongata).

[1] The author desires to express his indebtedness to Mr. Ge Tryon, Jr., through whose kind assistance most of the comparis recent forms were made.

Mactra similis. = Hemimactra solidissima.
" lateralis.
Solecurtus Caribæus (Siliquaria Carolinensis).
Solen ensis (S. directus).
Pholas costata (P. arcuata).
" (Dactylina) oblongata (P. producta).

NOTE.—About ten other species have been considered by various authors to be equivalents of recent forms, but since their identification as such has been at best but very doubtful, and in most cases strictly erroneous, they have been omitted. Among these are:

Lucina anodonta, at one time considered by Mr. Conrad to be identical with a species living along the Florida coast. Although very closely resembling the *L. Floridana*, it may, nevertheless, be readily distinguished from it by the greater thickness of its shell, and the greater profundity of the lunules.

Cardita arata.—This species differs, as stated by Conrad (Mioc. Foss., p. 12), from the recent *C. Floridana* of the Florida coast in being proportionately longer and broader behind, and in having the ribs crossed by "crowded subsquamose transverse wrinkles," instead of "thick transverse tubercles."

Cardita granulata.—According to Conrad (Mioc. Foss., p. 13), this shell "so nearly resembles *C. borealis*, a recent species of the eastern coast, that I think it will prove to be the same, when more specimens of the latter shall be obtained for comparison." This identification, which was subsequently rejected by Conrad himself, has for its support the very similar general appearance presented by the two shells in question, but closer examination shows the *C. granulata* to be almost invariably a considerably more elevated (less rotund) form than the *C. borealis*.

Artemis intermedia.—Not readily confoundable with either the *A. concentrica* (Born) or *A. Floridana* (Conr.).

Cytherea Sayana.—More produced (less rounded) than the recent *C. convexa*.

Rangia clathrodonta.—More elongated than the recent *R. cyrenoides*.

Admitting both the positive and somewhat doubtful forms from the above list to be recent, then we have as a proportion to extinct forms 40 to 103, or 39 per cent.; or, if the six doubtful ones are omitted, 34 to 103, or 33 per cent.

The following recent species may be considered to occur in the North Carolina deposits.

Anomia ephippium.
Ostrea Virginiana.
Pecten Clintonius = P. Magellanicus.
Arca lienosa = A. Floridana.
Leda acuta.
Yoldia limatula (Leda lævis).
Nucula proxima = N. obliqua.
Chama arcinella.

? Cardita tridentata.
Gouldia lunulata.
? Cardium Carolinense = C. magnum ?
" muricatum.
Lucina Pennsylvanica.
" contracta = L. filosa.
" crenulata.
" radians = L. Antillarum.
" divaricata (L. Conradi).
" squamosa (L. speciosa) = pecten.
Venus mercenaria.
? Cytherea cribraria = C. punctulata ?
Tellina lusoria.
" alternata.
" polita.
Strigilla flexuosa.
Mactra oblongata = Standella fragilis.
" lateralis.
Mactra similis = Hemimactra solidissima.
Solen ensis.
Solecurtus Caribæus (Siliquaria Carolinensis).
Pholas costata (P. arcuata).
Pholas (Dactylina) oblongata.
? Pandora trilineata.

Of the above 32, which constitute 30 per cent. of the lamellibranchiate fauna of the State, all, with only one exception—*Pecten Clintonius* (*Magellanicus*)—also occur in the South Carolina deposits. Although the percentage of recent forms in the North

Lucina squamosa (L. speciosa) = L. pecten.
" crenulata
" divaricata.
" contracta = L. filosa.
? Venus mercenaria.
Tellina lusoria.
Cumingia tellinoides.
Pandora crassidens = P. trilineata.
Saxicava bilineata = S. rugosa.
? Pholas acuminata = P. costata ?

The percentage (15) is here, therefore, brought down considerably lower than in either of the preceding States, a circumstance not only strikingly confirming the assumption of non-contemporaneity (as has already been drawn from comparisons made between the different faunas themselves) in the deposits in question, but equally proving that the Virginia deposits are anterior (older) in date to those of both South and North Carolina.

The number of recent species occuring in the Maryland deposits taken as a whole (*i. e.*, as embracing both the "newer" and "older" groups, and comprising consequently 98 specific forms of acephalous mollusks) is somewhat less than in Virginia, namely (including two or three doubtful forms), 13:

Leda acuta.
Yoldia limatula (Leda lævis).
Nucula proxima = N. obliqua.
Lucina crenulata.
" contracta = L. filosa.
" divaricata.
Ostrea Virginiana.
Pecten Clintonius = P. Magellanicus.
Panopea Americana.[1]

[1] I have here provisionally included the *Panopæa Americana* among the recent forms, although I am somewhat doubtful as to its right to a place there. The shell certainly very greatly resembles that of the recent *P. Aldrovandi* from the Mediterranean, from which, in fact, it appears to differ only in the form of the posterior truncature, which in the recent species carries up the hinge line to a higher level than in the fossil. While the form of the American shell is very constant, that of the European is stated to be very varying, and therefore the distinction pointed out may on a closer examination between specimens be found to have no specific value. By Searles Wood ("Monograph of the Crag Mollusca," ii, p. 283, Palæontogr. Soc. Reports) the *P. Americana* (and *P. reflexa*) is considered identical with the *P. Faujasii* (more properly *P. Menardi*), a common

?Venus mercenaria.
Solen ensis.
Saxicava rugosa (S. bilineata).
?Pholas ovalis . . P. costata?

Of this number 12 are found in the deposits of the "newer" group, and consequently constitute about 18 per cent. of its lamellibranch fauna; on the other hand, at most, only 2 occur in the deposits of the "older" group. We have here, therefore, not only a further corroboration of the existence in the State of two distinct horizons, but what might almost be considered positive proof that the upper Maryland formation ("newer" group), occupies a horizon very nearly identical with that of the (or the great bulk of the) Virginia formation, and one considerably lower than that indicated by the South and North Carolina deposits, despite the circumstance that the general relations existing between the respective faunas in the two cases are not very different.

The following statement summarizes the results obtained from the examination of the lamellibranch fauna:

Of about 103 South Carolina species—
74–78 are found in North Carolina = 74 per cent.
43 are found in Virginia = 42 per cent.
34 are found in Maryland = 33 per cent.
34–40 are recent = 33–39 per cent.

Of about 106 North Carolina species—

[redacted]

Of about 98 Maryland species—
34 are found in South Carolina = 35 per cent.
36 are found in North Carolina = 37 per cent.
41 are found in Virginia = 42 per cent.
13 are recent = 13 per cent.

Of about 66 Maryland "Newer" group species—
33 are found in South Carolina = 50 per cent.
32 are found in North Carolina = 49 per cent.
37 are found in Virginia = 56 per cent.
12 are recent = 18 per cent.

Of about 32 Maryland "Older" group species—
4 are found in South Carolina = 13 per cent.
7 are found in North Carolina = 22 per cent.
8 are found in Virginia = 25 per cent.
2 are recent = 7 per cent.

The examination of the gasteropod faunas of the several States, as will be seen from the summary further on, very strongly confirms the results that have been obtained from the investigation of the acephalous mollusks.

The following enumeration exhibits the species that have been described from the deposits of South and North Carolina.

SOUTH CAROLINA.

Cancellaria reticulata,	N. C.	Dentalium Pliocenum.	
" depressa.		" thallus,	N. C.
" venusta.		Dolium galea.	
Conus adversarius,	N. C.	Ecphora quadricostata,	N. C.
" diluvianus,	N. C.	Fasciolaria distans,	N. C.
Crucibulum multilineatum,	N. C.	— F. tulipa.	
" costatum,	N. C.	" (?) gigantea.	
" ramosum,	N. C.	" Tuomeyi.	
" dumosum,	N. C.	Fulgur carica,	N. C.
Cypræa Carolinensis,	N. C.	" perversus,	N. C.
Crepidula fornicata,	N. C.	" canaliculatus,	N. C.
" spinosa,	N. C.	" Conradi (incile).	
— C. aculeata.		" Carolinensis.	
" plana,	N. C.	(F. excavatus),	N. C.
— C. unguiformis.		" pyrum.	
" costata.		(F. spiratus),	N. C.
Columbella avara.		Ficus reticulatus,	N. C.
Dentalium attenuatum,	N. C.	Fusus exilis,	N. C.
— D. dentale.		Fissurilla redimicula,	N. C.

Galeodia Hodgei, N. C.
Hipponyx Bullii.
Infundibulum centralis, N. C.
Littorina irrorata.
Marginella limatula, N. C.
" oliviformis, N. C.
Mitra Carolinensis, N. C.
Monodonta Kiawahensis.
Murex umbrifer, N. C.
Natica heros, N. C.
" duplicata, N. C.
" canrena, N. C.
" Caroliniana.
Nassa vibex, N. C.
" trivittata, N. C.
" obsoleta, N. C.
" (?) lunata.
Obeliscus arenosa, N. C.
Oliva literata, N. C.
Pleurotoma lunata, N. C.
Ptychosalpinx porcinum, N. C.
" multirugatum, N. C.
Purpura tridentata.
Petaloconchus sculpturatus, N. C.
Ranella caudata, N. C.
Scalaria multistriata, N. C.
" clathra, N. C.
— S. angulata.
Solarium perspectivum.
Terebra Carolinensis, N. C.
" unilineata, N. C.
Trivia pediculus, N. C.
Turritella striata.
" exaltata.
" Burdenii, N. C.
" Etiwaensis, N. C.
Trochus philantropus, N. C.
" armillatus.
" gemma.
Urosalpinx cinerea.
Voluta mutabilis, N. C.
" Trenholmii, N. C.
Vermetus anguina.

NORTH CAROLINA.

Cancellaria Carolinensis.
— C. reticulata, S. C.
Caecum annulatum.
Cerithium moniliferum.
Dentalium attenuatum, S. C.
— D. dentale.
" thallus, S. C.
Dolium octocostatus.

[redacted]

Fulgur pyrum.	
= F. spiratus,	S. C.
Ficus reticulatus,	S. C.
Fusus exilis,	S. C.
" equalis.	
" lamellosus.	
" moniliformis.	
Fissurella redimicula,	S. C.
Galeodia Hodgei,	S. C.
Infundibulum centralis,	S. C.
Littorina lineata.	
Marginella limatula,	S. C.
" oliviformis,	S. C.
" constricta.	
" ovata.	
" inflexa.	
" elevata.	
Mitra Carolinensis,	S. C.
Murex umbrifer,	S. C.
" globosa.	
Natica heros,	S. C.
" duplicata,	S. C.
" canrena,	S. C.
" fragilis.	
" percallosa.	
" Emmonsii.	
Nassa vibex,	S. C.
" trivittata,	S. C.
" obsoleta,	S. C.
" (Tritia) multilineatum.	
" " moniliformis.	
" " bidentata.	
Obeliscus arenosa,	S. C.
Oliva literata,	S. C.
Oliva ancillariæformis.	
" canaliculata.	
Pleurotoma lunata,	S. C.
" limatula.	
" communis.	
" elegans.	
" tuberculata.	
" flexuosa.	
Ptychosalpinx porcinum,	S. C.
" multirugatum,	S. C.
Petaloconchus sculpturatus,	S. C.
Pyramidella reticulata.	
Ranella caudata,	S. C.
Scalaria multistriata,	S. C.
" clathra,	S. C.
" curta.	
Terebra Carolinensis,	S. C.
" unilineata,	S. C.
" neglecta.	
Tornatina cylindra.	
Trivia pediculus,	S. C.
Turritella Burdenii,	S. C.
" Etiwænsis,	S. C.
" constricta.	
Turbonilla reticulata.	
Trochus philantropus,	S. C.
Voluta mutabilis,	S. C.
" Trenholmii,	S. C.
" obtusa.	
Helix tridentata.	
" labyrinthica.	
Planorbis bicarinatus.	
Paludina subglobosa.	

A comparison of the two preceding tables shows, that of the 74 South Carolina forms no less than 52 (or 70 per cent.) are common to the deposits of North Carolina, a proportion very nearly identical with that which obtains in the case of the acephalous mollusks (74 per cent.). This very close agreement leaves but little, if any, room for doubt as to the contemporaneity of the formations of the two States. In North Carolina the number of specific forms described is considerably in excess of that from the former State, and consequently, as must almost necessarily follow, the percentage of common forms is here very materially reduced.

Thus of 100 species—4 of which are non-marine—only 52, as above stated, also occur in South Carolina, or just 52 per cent. It is but fair to presume, however, that were the number of species described from South Carolina equal to that from North Carolina the proportion of forms common to the two States while it would not probably differ very materially from what we now find it in the former State, would be considerably raised for the latter. On the other hand, just the reverse result presents itself when a comparison is made with the Virginia fauna, which comprises a far greater number of species than is to be found in any other State:

VIRGINIA.

Amycla reticulata.
Actæon (?) milium.
Adeorbis (Delphinula) costulata.
" " concava. (A. lipara).
" " obliqué-striata.
Anguinella Virginiana.
Bela Dædalia.
Buccinum Tuomeyi.
" frumentum.
Crepidula costata, S. C.
" fornicata, S. C.; N. C.
" spinosa, S. C.; N. C.
" ponderosa.
" cornucopiæ.

Dentalium thallus, S. C.; N. C.
" attenuatum, S.C.; N.C. = D. dentale.
Delphinula trochiformis.
" (Carinorbis) arenosa.
" lyra.
Ecphora quadricostata, S.C.; N.C.
Eulima (Pasithea) lævigata, N.C.
" eborea.
" migrans.
Eulimella (Pasithea) ovulum. (E. diaphana).
Fasciolaria parvula.
" rhomboidea, S. C.; N. C.

[redacted]

Marginella eburneola.
Mangelia Virginiana.
Menestho limnea.
Melampus (?) longidens.
Nassa trivittata, S. C.; N. C.
" impressa.
" (Tritia) altilis.
" bilix.
" " laqueata.
Natica duplicata, S. C.; N. C.
" heros, S. C.; N. C.
" aperta, N. C.
(N. fragilis ?).
" sphærula, N. C.
(N. percallosa ?).
" perspectiva.
Niso lineata.
Oliva canaliculata, N. C.
" ancillariæformis, N. C.
" Carolinensis.
= O. literata, S. C.; N. C.
" eborea.
Obeliscus arenosa, S. C.; N. C.
(Pyramidella suturalis).
Odostomia (Actæon) granulatus.
" (?) globosus.
" " turbinatus.
" " angulatus.
" " glans.
" " sculptus.
" " nitens.
Patella acinaces.
Petaloconchus sculpturatus,
S. C.; N. C.
Pleurotoma lunata, S. C.; N. C.
" pyrenoides.
" (Drillia) multisecta.
" " arata.
" " bella.
" " distans.
" " dissimilis.
" " eburnea.
" " impressa.
" (Surcula) engonata.
" " nodulifera.
Pleurotoma (Surcula) tricenaria.
" " Virginiana.
Pyramidella elaborata.
Ptychosalpinx porcinum,
S. C.; N. C.
Rotella nana.
" subconica.
" carinata.
" lenticularis.
" umbilicata.
Scalaria clathra, S. C.; N. C.
" = S. angulata.
" acicula.
" micropleura.
" microstoma
(S. cornigera ?).
" pachypleura.
" procera.
Solarium nupera.
Trochus philanthropus, S.C.; N.C.
" armillus.
" conus.
" lens.
" torquatus.
" Ruffinii.
" bellus.
" labrosus.
" Mitchelii.
Turbo rusticus.
" (Monilea) caperata.
Trophon tetricus.
Turritella variabilis.
" indenta.
" plebeia.
" alticosta.
" flexionalis.
" terstriata.
" bipertita.
Trochita (Infundibulum)
concentrica.
Triforis (Cerithium) monilifera.
Urosalpinx cinerea.
Vermetus convolutus.
Voluta mutabilis, S. C.; N. C.
Vivipara (Turbo) glaber.

NOTE.—Several species described by H. C. Lea (Amer. Philos. Trans.,

new ser., vol. ix), considered to have been founded on insufficiently determined characters, or on the immature forms of previously described species, have been intentionally omitted.

We find that of the 141 species here enumerated only about 26 are found in the deposits of South Carolina, which would give to that State a comparatively low percentage of common forms (35), and one considerably less than that (42) which was found to exist when the acephalous mollusks were taken as the basis of comparison. Nor is the number of Virginia forms (31) occurring in North Carolina much more numerous, and here, likewise, the percentage (31) is markedly lower than was found to be the case (46) in the first method of comparison. Taking these various facts together they are abundantly conclusive as to the correctness of the inference drawn from the testimony of the lamellibranchs, that the Virginia deposits represent a horizon different from that indicated by the South and North Carolina formations.

From the Maryland deposits taken as a whole, *i. e.*, as comprising both the "newer" and "older" groups, there have thus far been described about 105 species of gasteropodous mollusks: of these, as will be seen from the following table, about 21 (20 per cent.) also occur in South Carolina, and 26 (or 25 per cent.) in Virginia. While the proportion of forms common to the two States is thus shown to be very limited in either case, and decidedly less than was found to exist among the lamellibranchs, there is yet (as was also indicated in the lamellibranch comparisons) a slight advantage in favor of Virginia.

MARYLAND—NEWER GROUP.

Actæon ovoides.
" melanoides.
Bulla (?) acuminata.
Cancellaria corbula.
" lunata.
" alternata.
Cassis (Semicassis) cælata.
Crucibulum grande, Va.
" tubiferum.
" costatum, S. C.; N. C.; Va.
Conus diluvianus, S. C.; N. C.
" Marylandicus.
Columbella communis.
" avara, S. C.
Dentalium thalloides.
" attenuatum, S. C.; N. C. Va. = D. dentale.
Ecphora quadricostata, S. C.; N. C.; Va
Fusus (Neptunea) parilis.
" " errans (rusticus)
" sulcosus.
" strumosus, Va
Fissurella alticosta.
" nassula.
" redimicula, S. C.; N. C.; Va
Fulgur rugosus?

Fulgur coronatus.
" canaliculatus, S. C.; N. C.; Va.
" tuberculatus.
" carica, S. C.; N. C.; Va.
" fusiformis.
" alveatus?
Ficus? (Pyrula) sulcosa.
Marginella denticulata.
Melanopsis (Bulliopsis) ovata.
" integra, Va.?
" Marylandica.
Natica interna.
" duplicata, S. C.; N. C.; Va.
" heros, S. C.; N. C.; Va.
" fragilis, N. C.; Va.
Nassa trivittata, S. C.; N. C.; Va.
" obsoleta, S. C.; N. C.
" lunata, S. C.
" quadrata.
" prærupta.
" porcinum, S. C.; Va.
" arata.
Pleurotoma bicatenaria.
" limatula, N. C
" communis, N. C.
" parva.
" rotifera.
Pleurotoma gracilis.
" dissimilis, Va.
Ranelia centrosa, S. C.? N. C.?
— R. caudata?
Scalaria clathra, S. C.; N. C.; Va.
— S. angulata.
" expansa.
Terebra simplex.
" curvilineata.
" loxonema.
Trochus humilis.
" reclusus.
" Bryanii.
Turbo (Monilea) distans.
" " eborea.
Turritella plebeia, Va.
" variabilis, Va.
" laqueata.
" solitaria.
" alticosta, Va.
" octonaria.
Turbinella demissa.
Turbonilla perlaqueata.
Trophon tetricus, Va.
Typhis acuticostata.
Urosalpinx cinerea, S. C.; Va.
Voluta mutabilis, S. C.; N. C.; Va.
" solitaria.

Maryland—Older Group.

Buccinum? protractum.
" lienosum.
Bulla subspissa.
Cancellaria biplicifera.
" engonata.
Crucibulum ramosum, S. C.; N. C.; Va.
" constrictum.
Dentalium thalloides.
Fissurella Marylandica.
Fusus migrans.
" (Neptunea) devexus.
Marginella perexigua.
Niso lineata, Va.
Pleurotoma Marylandica.
" bellacrenata.
" rugata.
Scalaria pachypleura, Va.
Solarium trilineatum.
Sigaretus fragilis.
Trochita (Infundibulum) perarmata.
Turritella indenta, Va.
" exaltata, S. C.
" perlaqueata.
Trochus peralveatus.
Valvula iota.
Voluta mutabilis, S. C.; N. C.; Va.
" solitaria.

Taking each of the two Maryland divisions, already referred to,

by itself, we find that of the 21 forms occurring also in South Carolina, 19 belong to the deposits of the "newer" group, which comprise in all about 78 species; the percentage of forms common to the two formations—25—is thus considerably above that which was found to obtain when the State formation was considered as a whole. And the same increased percentage is determined when the Virginia forms are considered. Of the 26 indicated in the preceding enumeration, 22 belong to the "newer" group, of whose fauna they consequently constitute 28 per cent. The 27 species belonging to the "older" group have only 3 (or 10 per cent.) common with South Carolina, and 5 (or 18 per cent.) common with Virginia. In comparing the gasteropod faunas of the two Maryland divisions with each other, we find that there are only three species whose range embraces the deposits of both series. From the preceding data it will be seen that very strong confirmation is lent to the conclusions derived from the examination of the lamellibranch fauna as to the non-contemporaneity of the South Carolina (*et conseq.*, North Carolina) deposits with those of Virginia and Maryland, and to the existence of two well-marked faunal horizons in the last named State. No conclusive evidence is, however, afforded relative to the position which the Virginia and Maryland deposits hold in respect of each other; for the determination of this point, as well as for the determination of the several horizons, testimony must again be sought in the rela-

Dolium galea.
Columbella avara.
Oliva literata (O. Carolinensis).
Ranella (Bursa) caudata.
Cancellaria reticulata (C. Carolinensis).
Fulgur carica.
" perversum (F. adversarium).
" canaliculatum (F. canaliferum).
" pyrum.
Urosalpinx cinerea (Peristernia filicata).
Fasciolaria distans (F. rhomboidea) — F. tulipa.

NOTE.—Three or four additional species, for several reasons here omitted, may, on further examination, be found to be identical with recent forms.

Thus out of a total number of 74 species about 27 are still found living at the present day; the percentage of recent to extinct species—37—is therefore not very different from that which was found to obtain among the acephalous mollusks.

The following recent species may be considered to occur in North Carolina:

Dentalium attenuatum — D. dentale.
Crepidula fornicata.
" spinosa — C. aculeata.
" plana — C. unguiformis.
Natica heros (N. catenoides).
" duplicata.
Natica canrena (N. plicatella).
Scalaria multistriata.
" clathrus = S. angulata.
Obeliscus arenosa.
Trivia pediculus.
Nassa vibex.
" trivittata.
" obsoleta.
Olva literata (O. Carolinensis).
Ranella (Bursa) caudata.
Cancellaria reticulata (C. Carolinensis).
Fulgur carica.
" perversum (F. contrarium).
" canaliculatum.
" pyrum (F. spirata).
Fasciolaria distans — F. tulipa.

All of the above 22 species, which constitute 22 per cent. of the

gasteropod fauna of the State, are found also in South Carolina. We have here, just as in the case of the lamellibranch fauna, a decided decrease when compared with the last mentioned State in the proportion of living forms, but yet, as before, the very well marked correspondence or identity existing generally between the two faunas would preclude the supposition of the representation by them of two distinct horizons.

In Virginia and Maryland the number of recent species is considerably less than in either South or North Carolina, and the proportion these bear to extinct forms is also very materially reduced. Thus of about 141 Virginia species only 12 (or 8½ per cent.) can be considered as being identical with living forms, namely:

Dentalium attenuatum = D. dentale.
Crepidula fornicata.
" spinosa = C. aculeata.
Natica duplicata.
" heros (N. catenoides).
Fulgur carica.
" canaliculata.
O. Carolinensis = O. literata.
Scalaria clathra = S. angulata.
Nassa trivittata.
Obeliscus arenosa (Pyramidella suturalis).
Urosalpinx cinerea.

[redacted]

The percentage of recent forms is here, therefore, brought up to fourteen, or very nearly that (15), which obtains among the Virginia lamellibranchs, and 4 per cent. below that which was found to characterize the lamellibranch fauna for the same group of deposits.

Summing up the results obtained from the examination of the gasteropod fauna. we find that—

Of about 74 South Carolina species—
52 are found in North Carolina = 70 per cent.
26 are found in Virginia = 35 per cent.
21 are found in Maryland = 29 per cent.
27 are recent = 37 per cent.

Of about 100 North Carolina species—
52 are found in South Carolina = 52 per cent.
31 are found in Virginia = 31 per cent.
18 are found in Maryland = 18 per cent.
22 are recent = 22 per cent.

Of about 141 Virginia species—
26 are found in South Carolina = 19 per cent.
31 are found in North Carolina = 22 per cent.
26 are found in Maryland = 19 per cent.
12 are recent = 8½ per cent.

Of about 105 Maryland species—
21 are found in South Carolina = 20 per cent.
18 are found in North Carolina = 17 per cent.
26 are found in Virginia = 25 per cent.
11 are recent = 11 per cent.

Of about 78 Maryland "Newer" group species—
19 are found in South Carolina = 25 per cent.
17 are found in North Carolina = 22 per cent.
22 are found in Virginia = 28 per cent.
11 are recent = 14 per cent.

Of about 27 Maryland "Older" group species—
3 are found in South Carolina = 10 per cent.
2 are found in North Carolina = 8 per cent.
5 are found in Virginia = 19 per cent.
0 recent.

It will be readily perceived from the preceding summai statement, that the general results obtained from the examina of the gasteropod faunas abundantly confirm the conclus drawn from the study of the acephalous mollusks. Combi the results obtained from the two methods of comparison find that:

Of about 177 South Carolina mollusca—
128 are found in North Carolina = 72 per cent.
69 are found in Virginia = 39 per cent.
55 are found in Maryland = 31 per cent.
61–67 are recent = 35–38 per cent.

Of about 206 North Carolina mollusca—
128 are found in South Carolina = 62 per cent.
79 are found in Virginia = 38 per cent.
54 are found in Maryland = 26 per cent.
54 are recent = 26 per cent.

Of about 250 Virginia mollusca—
69 are found in South Carolina = 28 per cent.
79 are found in North Carolina = 32 per cent.
67 are found in Maryland = 27 per cent.
28 are recent = 11 per cent.

Of about 203 Maryland mollusca—
55 are found in South Carolina = 27 per cent.
54 are found in North Carolina = 27 per cent.
67 are found in Virginia = 33 per cent.
24 are recent = 12 per cent.

Of about 144 Maryland "Newer" group mollusca—
52 are found in South Carolina = 36 per cent.
49 are found in North Carolina = 34 per cent.
59 are found in Virginia = 41 per cent.
23 are recent = 16 per cent.

Of about 59 Maryland "Older" group mollusca—
7 are found in South Carolina = 12 per cent.
9 are found in North Carolina = 15 per cent.
13 are found in Virginia = 22 per cent.
2 are recent = 4 per cent.

Summary.

The following points in stratigraphy, it is believed, may be considered as being conclusively demonstrated through the foregoing comparisons :

1. That the South and North Carolina deposits represent approximately the same geological horizon ;

2. That the Virginia deposits indicate a horizon lower (older) in the geological scale than that of either of the formations just mentioned ;

3. That the Maryland deposits indicate two well-marked faunal horizons, of which the upper one is the correspondent of the Virginian.

REMARK.—It will be seen from the last table that the correspondence existing generally between the Maryland deposits taken as a whole (i. e., including both "newer" and "older" groups) and those of Virginia, is greater than that which obtains between the last and the deposits of the "newer" group (upper Maryland horizon) considered alone, and, hence, it might readily be concluded that the Virginia and Maryland formations are absolutely equivalents of each other. But, as it has already been shown, the Maryland deposits almost unquestionably represent two well-defined faunal horizons, and, therefore, unless such is likewise found to be the case in Virginia—which *appears to be highly probable*, although evidence proving the same is still insufficient—no general correlation can be insisted upon.

Having ascertained the relations which the deposits of the several States hold towards each other, it remains lastly to determine what are the horizons, as generally recognized by geologists, that they represent. The low percentage of living forms which characterizes the molluscan faunas of the Maryland and Virginia deposits leaves no doubt as to the miocene age of these last ; the "older" group of Maryland, therefore, represents the base of the miocene series. As for the North and South Carolina deposits, their position is somewhat more difficult to pronounce upon. The percentage of recent forms occurring in South Carolina is

such as to permit, according to the original Lyellian classification of the tertiary strata, of the deposits of that State being referred to the pliocene period. The North Carolina deposits, on the other hand, would according to the same system of classification be relegated to the miocene period, and yet, as has already been seen, the identity existing between the faunas of the two States is altogether too great to admit of any reasonable doubt as to their contemporaneity. Nor is the difficulty of determination lessened when an appeal is made to European deposits of nearly similar age, which have served to elucidate the principles of the Lyellian classification. Thus in what might be considered to be the two typical areas for the occurrence of marine pliocene deposits in Europe—Italy and England—the percentages of recent forms characterizing the contained faunas vary within very broad limits. Foresti has shown (*vide* Fuchs, *Die Gliederung der Tertiärbildungen am Nordabhange der Apenninen von Ancona bis Bologna*, Sitzb. d. k. Akademie der Wissenschaften, lxxi, p. 177, Vienna, 1875) that the so-called pliocene of the Bolognese Apennines may be divided into four faunal horizons, the deposits belonging to which are characterized by the following percentages of recent forms:

	Total number of species.	Living.	Percentage of living forms.
IV.	141	112	79.4
III.	332	144	43.3
II.	183	71	38.8
(Oldest) I.	78	24	30.7

Nos. I and II, therefore, correspond very closely in the proportion of living forms with the North and South Carolina deposits. But just this division of the sub-Apennine formation, or its equivalent, is by many Italian geologists referred to the upper miocene, and, indeed, it would appear more natural, if the percentage of living forms is to remain the principal basis for the classification of the tertiary formations, to group the doubtful deposits here, and thereby increase the latitude of the miocene, than where they have very generally been placed, unless, as would seem from the observations of Pareto (*Les terrains tertiaires de l'Apennin septentrional*, Bulletin de la Société Géologique de France, 2d ser., vol. xxii, 1864–5, p. 237, *et seq.*), and Fuchs (*loc. cit.*), strati-

graphical evidence is decidedly contrary to such an approximation.[1] In the English pliocene faunas the percentages of recent forms are very much higher than in the Italian just referred to.[2] The following table exhibits the numerical relations of the living and extinct species, which together constitute the crag molluscan fauna (Lyell, "Student's Elements of Geology," 1878, p. 183, *emend*):

	Total number of species.	Living.	Percentage of recent forms.
NEWER PLIOCENE.			
Chillesford beds,	88	74	84.1
Norwich, (Fluvio-marine),	112	94	84
OLDER PLIOCENE.			
Red Crag, (exclusive of derivatives),	248	179	72.2
Coralline Crag,	396	• 252	63.6

It will thus be seen that the number of recent forms occurring in the *oldest* division of the British pliocene deposits is, proportionately to the extinct species, very much greater—in fact, not far from twice as great—than that which has been found to exist

[1] A direct continuity between the upper miocene (Tortonian) and the Bolognese sub-Apennine (pliocene of most authors) formations is maintained by Capellini (Sui Terreni Terziari di una parte del versante settentrionale dell 'Apennino, Mem. Accad. Scienze, Istit. Bologna, ser. iii, vol. vi, p. 618, 1876). Under the strata designated as the mio-pliocene ("Messinian" of Mayer), corresponding in a general way with the "Sarmatian" and "Congerian" of the Austrian geologists, and consequently comprising (as generally recognized by geologists) deposits of both miocene and pliocene age, are included I and II of Foresti's faunal horizons—the lower sub-Apennine marls and sands of Capellini (upper Messinian of Mayer). The upper marls and sands (III and IV) are referred to the "Astian" (or pliocene proper of Capellini). This classification appears to be more in consonance with the facts presented by paleontology than the one usually followed.

[2] Foresti has called attention (*Catalogo dei Molluschi Pliocenici delle Colline Bolognesi*, Mem. Accad. Scienze, Istit. Bologna, ser. ii, vol. vii, p. 548, 1867) to the much greater relationship which the fauna of the Bolognese sub-Apennine formations bears to the fauna of the Vienna basin than to that of the British crag, and from this circumstance draws the inference, that the Italian deposits represent a horizon very close to the miocene ("*rappresentano un plano geologico vicinissimo al miocene*," . . .).

in the case of the South Carolina deposits. While it may be safe to affirm, from this disparity existing between the American and English faunas, that the formations represented by them are in no way equivalents of each other, (an equivalency, as has already been stated, that had been assumed by Lyell), it may yet be rash to conclude from this reason alone that, broadly measured, they do not belong to the same period (pliocene) of geological time, the more especially, since (as will be seen from a comparison of the British and Italian faunal tables) a nearly equal disparity obtains between the faunas of the Crag and some of the sub-Apennine deposits considered to belong to the same period. Nor would it be safe to affirm conclusively, although the evidence in this direction may be considered to be sufficiently strong, that the American deposits in question are correlative of that portion of the sub-Apennine formation, which, by some geologists, has been referred to the upper miocene, or classed as mio-pliocene. While it may thus be difficult to determine *absolutely* whether the South Carolina deposits (and, consequently, also the North Carolinian) ought to be classed as pliocene or miocene, yet, in view of the fact that thus far no tertiary beds have been discovered in that State, nor probably anywhere else along the Atlantic coast, whose fauna more closely approximates that of the present day, and the broad hiatus that is thus created between them and the succeeding post-pliocene, in which, as determined by Holmes ("Post-Pleiocene Fossils of South Carolina," 1860, Introduc., pp. 3 and

Upper Atlantic miocene, represented by the South and North Carolina deposits.

Middle Atlantic miocene, represented by the whole, or the greater part of the Virginia deposits, and those of the Maryland "newer" group.

Lower Atlantic miocene, represented by the deposits of the Maryland "older" group, and possibly the lower portion of the Virginia formation.

To these three groups, commencing with the oldest, it is proposed to apply the designations of "Marylandian," "Virginian," and "Carolinian," respectively.

The sequence of the tertiary formations along the Atlantic and Gulf slopes of the United States would, therefore, be approximately as follows:

be considered to occur, or to have their analogues in the crag (pliocene) deposits:

Anomia ephippium.
Ostrea Virginiana, represented by O. edulis.
Lucina filosa — L. borealis.
" crenulata.
Lucina dentata?
Nucula obliqua = Nucula nucleus?
Astarte bella, represented by Astarte gracilis.
" undulata, represented by A. Omalii.
Artemis intermedia, represented by A. lentiformis.
Mactra lateralis, represented by Mactra ovalis.
Solen ensis.
Pandora trilineata — P. inequivalvis?

The following may be said to occur, or to have their analogues in the deposits of the Vienna basin:

Anomia ephippium, represented by A. costata.
Arca plicatura, represented by A. diluvii.
Nucula obliqua = N. nucleus?
Lucina squamosa = L. pecten (reticulata).
" filosa — L. borealis.
" anodonta = L. Miocenica?
" divaricata, represented by L. ornata?
Chama corticosa, represented by C. gryphina.
Cardium magnum, represented by C. Kübeckii.
Artemis intermedia, represented by A. lentiformis.
Pandora trilineata — P. inequivalvis?

[redacted]		
	?	
	of South and North Carolina ter" epoch of Dana).	
	of Virginia, and of the "Newer" of Maryland ("Yorktown" epoch, , of Dana).	Probably of the age of the "Second Mediterranean" of the Austrian geologists, and of the faluns of Touraine.
	of the "Older" group of Maryand possibly the lower Miocene f Virginia ("Yorktown" epoch, , of Dana).	Probably (or at least partially) the equivalent of the "First Mediterranean" of the Austrian geologists, and of the faluns of Léognan and Saucats.
	haracterized by species of *Orbi-* etc. Vicksburg beds, Florida tc.	
	beds of Mississippi—"White one" of Alabama.	
	rous arenaceous deposit of Clai- Ala., etc.	Age of the "Calcaire Grosssier" of France (Parisian).
	ow the true Claibornian on the na River. "Chalk Hills" of the rn part of the State, etc. "Sili- Claiborne" (Hilgard) of Missis-	Londonian?
	sands, and clays situated at the f the Tertiary series in Alabama, Eocene beds of Maryland?	Thanetian?

REMARK.—In the above table, in most instances, only the *more prominent* localities for the occurrence of the several deposits have been given, and the absence of reference to certain States, therefore, does not indicate that deposits of a given age are there wanting. The "Jacksonian" beds, which are generally placed at the top of the eocene series, may, on further examination, prove to be oligocene. By some geologists a portion of the post-eocene tertiary deposits of New Jersey, Delaware and Maryland has been referred to the pliocene period, but there does not appear to be as yet sufficient evidence to support such a conclusion. No precise correlation between the entire series of the Atlantic tertiary deposits of the United States and those of Europe can thus far be said to have been determined. There can be no doubt as to the parallelism existing between the Claibornian and the "Calcaire Grossier" (Parisian) of France; but as for the immediately overlying and underlying eocene deposits, their relations can only be approximately fixed from the positions which they occupy in their own series. The "Buhrstone" appears to represent a portion, or perhaps even a greater part of the "Londonian," and the Marlborough and Piscataway beds of Maryland (eo-lignitic?), a horizon probably not far removed from that of the Bracheux sands of the Paris basin, or the Thanet sands of England (Thanetian).[1] The exact equivalents of the "Orbitoitic" have not yet been satisfactorily made out. There can be little or no doubt respecting the position of the "Virginian," whose faunal facies places it at about the horizon of the faluns of Touraine, and the "Second Mediterranean" beds of the Vienna basin; nor can there be much more doubt as to the equivalency, at least in part, of the "Marylandian" and the lower miocene beds of the Vienna basin ("First Mediterranean").[2]

[1] Heilprin, Proc. Acad. Nat. Sciences, 1881, p. 446.

[2] The proportions which the recent species of mollusca bear to the extinct forms is larger in the *older* deposits of the Vienna basin than in the newer; the percentages for the two divisions of the "Mediterranean" are twenty-one for the "First," and fifteen for the "Second" (Fuchs, *Geologische Uebersicht der jüngeren Tertiärbildungen des Wiener Beckens.* Führer zu den Excursionen der D. Geolog. Gesellschaft, Vienna, 1877, p. 103). The following species of Virginia and Maryland lamellibranchiata may be con-

The relations of the "Carolinian" have already been fully d cussed.[1]

sidered as occurring, or having their analogous in the deposits of the Vien basin and the British crag:

VIENNA BASIN.

Saxicava rugosa (bilineata) = S. arctica.
Panopæa Americana, represented by P. Menardi.
Venus latilirata, represented by V. scalaris?
Isocardia fraterna, represented by I. cor.
Chama corticosa, represented by C. gryphina.
Lucina anodonta = L. Miocenica?
" contracta (filosa) = L. borealis.
" divaricata, represented by L. ornata.
" squamosa (speciosa) = L. pecten (reticulata).
Nucula obliqua = N. nucleus?
Arca plicatura, represented by A. diluvii.
Myoconcha incurva, represented by Mytilus Haidingeri?
Perna maxillata = P. Soldanii.

CRAG.

Ostrea Virginiana, represented by O. edulis.
Lucina filosa (contracta) = L. borealis.
" crenulata (Conrad) = L. crenulata (Wood)?
" dentata.
Nucula obliqua = N. nucleus?
Erycinella ovalis.
Astarte undulata, represented by A. Omalii.
Panopæa Americana, represented by P. Menardi.
" porrecta = P. gentilis?
Pandora arenosa (trilineata *pars?*), represented by P. pinna.
Saxicava rugosa.
Isocardia fraterna, represented by I. cor.

[1] It is not improbable that the age of the beds of this period will be m nearly represented by that of the deposits of the lower ("Black") Antw Crag (Diestian), considered by most Belgian geologists to form the base the pliocene series of that country (Dewalque, *Prodrome d'une Descript Géologique de la Belgique*, 1880, p. 254), and by Lyell ("Studer Elements," p. 185), as the "first links of a downward passage from strata of the pliocene to those of the upper miocene period." T percentage (46) of recent molluscan forms characterizing the fauna these Belgian deposits, as determined by Lyell in 1852 ("On the Terti Strata of Belgium and French Flanders," Journ. Geol. Soc. London, VI p. 293), is, however, considerably higher than that which has been sho to be the case with the Carolinian fauna.

JUNE 20.

The President, DR. LEIDY, in the chair.

Twenty-nine persons present.

A paper entitled "On the occurrence of Nummulitic Deposits in Florida, and the association of Nummulites with a fresh-water Fauna," by Angelo Heilprin, was presented for publication.

JUNE 27.

Rev. Henry C. McCook, D.D., Vice-President, in the chair.

Twenty-two persons present.

The following papers were presented for publication :—

"On supposed Tertiary Ammonites," by J. S. Newberry.

"On the age of the Tejon Rocks of California and the occurrence of Ammonitic Remains in Tertiary Deposits," by Angelo Heilprin.

The death of Mrs. Eleanor P. Long, a member, was announced.

Distribution of Nerves.—Dr. HARRISON ALLEN called attention to the nerves as they were found in birds and other animals. He had detected that the arrangement of the follicles for the feathers (*pteryls*), an account of which Nitzsch has elaborated in his memoir on Pterylography, was associated with peculiarities of distribution of the cutaneous nerves, and it was held by the speaker that a careful study of these nerves, in mammals as well as birds, would result in the elucidation of some interesting points in connection with the trophic nerves of the integument. He further spoke of the arrangement of the nerves in the anterior extremity of the mammal. He had found the deeper muscles, such as the Pronator Quadratus and Anconeus, supplied by long nerves, while the superficial muscles were supplied by much shorter ones. In *Menopoma* he had detected a branch of the ulnar nerve passing into the natatorial fold of skin present on the ulnar border of the forearm. He had found in this genus the musculo-spiral nerve and the ulnar nerve to arise from the same trunk, and suggested, as probable, that the deep conjunctions of these nerves in the brachial plexus of man would be found to be a constant one. The ulnar nerve is one of the most interesting in the series, and might be called the *manal nerve* since it is distributed entirely to

the hand and the muscles influencing it, and is well devel
forms in which the median is undeveloped. The muscle
forearm, to which the ulnar nerve goes—the Flexor Carpi
and the ulnar portion of the Flexor Profundus Digitoru
among the most interesting muscles in the limb. Both
are singularly constant. They are the most effective muscl
backward movement of the manus in swimming and in w
and in the case of the Flexor Carpi Ulnaris, in making te
portion of the wing membrane of the bat lying between the
and the side of the body. The course of some of the cu
nerves of the manus in the bat is indicated by raised fold
integument, which, when present, have systemic significan

Mr. Henry Howson was elected a member.

JULY 4.

MR. MEEHAN, Vice-President, in the chair.

Eleven persons present.

The death of Chas. L. Sharpless and that of Joseph
members, were announced.

The following were ordered to be published :—

ON THE OCCURRENCE OF NUMMULITIC DEPOSITS IN FLORIDA, AND THE ASSOCIATION OF NUMMULITES WITH A FRESH-WATER FAUNA.

BY ANGELO HEILPRIN.

Beside the so-called *Nummulites Mantelli* of Morton (" Synopsis Org. Rem. Cretac. Group," p. 45, 1834), a species now known to belong to the genus *Orbitoides*, only one other form of supposed Nummulite has been recorded as occurring fossil in any North American formation. This is the *Nummulites Floridanus* from the " upper Eocene limestone " of Tampa Bay, Florida, described by Conrad in Vol. II (new series) of the American Journal of Science and Arts " (1846). The species is there said to be abundant, and is referred to the subgenus *Assilina*[1] of D'Orbigny. The description given is brief, but at the same time very broad, and no reference of any kind is made to the internal chambers or the partitions of the test; nor does the figure appended to the description, which resembles a nummulite only in the circumferential outline, give the faintest indication of these characters. In fact, if Conrad's figure is at all carefully drawn, it would much more nearly indicate a species of the genus *Orbiculina* than of *Nummulites*. In the " Catalogue of the Eocene Annulata, Foraminifera, Echinodermata, and Cirrepedia of the United States," prepared by the same author (Proc. Acad. Nat. Sciences of Phila., vol. 17, p. 74, 1865) the form in question (*Cristellaria? Floridana* of D'Orbigny, *Prodrome de Paléontologie*, vol. II, p. 406) is referred to the new genus *Nemophora* of Conrad, the characters of which are not stated, and whose relations to *Nummulites*, if any such exist, are left to the imagination of the reader to determine.[2] In numerous specimens of rock fragments that have been kindly furnished from different parts of the State of Florida by Dr. Eugene A. Smith, State Geologist of

[1] By some authors the members of this group are considered to have distinctive characters sufficient to separate them as a genus apart from *Nummulites* (La Harpe, *Étude sur les Nummulites du Comté de Nice*, Bulletin de la Soc. Vaud. des Sc. Nat., vol. XVI, p. 211. 1879).

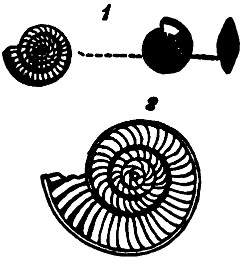
[2] As is the case with a very large proportion of Conrad's genera, no diagnosis of the "genus" *Nemophora* appears ever to have been furnished; at least, it has not been the good fortune of the writer to discover any such.

Alabama, and Mr. Joseph Willcox, of this city, the writer has carefully searched for foraminiferal remains that might with any amount of positiveness be identified with the form above referred to, but without success. While the *Operculina* (*Cristellaria!*) *rotella*, stated by Conrad (*loc. cit.*) to occur with the so-called Nummulite, was found in sufficiently great abundance in some of the rock fragments—in fact, largely entering into the composition of their incoherent masses—no trace of anything answerable to the latter could be detected, unless certain associated disciform bodies, measuring a quarter of an inch or more in diameter, and ornamented on the external surface with regular concentric lines of prominent granules, were actually the objects sought after.[1] But in these the spiral volutions represented by Conrad could not be detected, nor does that author make reference in his species to any external ornamentation consisting of granules. On the whole, we believe, it may be safely affirmed that the *Nemophora* had nothing in common with the genus *Nummulites* beyond a resemblance in outline, and the general community of character that would place all similar organisms in the one class of the foraminifera. The existence, therefore, of any fossil North American Nummulites may be considered to have been thus far at best but very doubtful.

But whatever doubt may have hitherto existed as to the occurrence of North American Nummulites, none such can any

[redacted]

completely envelop each other, and to which the most characteristic foreign representatives of the genus—*N. lævigatus*, *N. complanatus*, *N. planulatus*, *N. intermedius*, etc., belong. The tests, varying in size up to about $\frac{1}{3}$ inch in diameter, are in an excellent statė of preservation, and may be readily sliced open so as to show the internal structure. A central initial chamber is distinctly visible. To this species, belonging to the group of the *plicatæ* of D'Archiac, I would propose, from the name of its discoverer, the specific designation of *N. Willcoxi*.[1]



As to the age of the formation represented by these nummulitic deposits, there might appear to be at first sight no question of doubt. The presence alone of Nummulites in any formation is almost positive indication as to the eocene or oligocene age of that formation, and the more especially when the remains of these organisms occur in any abundance.[2] Admitting the supposition of this age, we should naturally look to the associated fossils for further confirmatory evidence bearing on this point. Singularly enough in the case of the Florida nummulitic rocks—at least in

[1] *Nummulites Willcoxi*: Test regularly rounded, tumid (more especially in the earlier stage), and measuring in the largest specimen about $\frac{1}{3}$ inch in diameter; external surface distinctly marked by the arcuate, and somewhat wavy outlines of the septal prolongations; volutions about 5, completely enveloping; septa close set, about 35–45 in the last whorl, and well flexed; central initial chamber distinctly visible.

While on further investigation this species may be found to be identical with one of the numerous forms described from the nummulitic deposits of Eur-Asia, from several of which it scarcely appears to differ, yet in the absence of actual specimens with which to institute direct comparisons, and the difficulty that attaches to the specific determination of this class of organisms, I have preferred to follow the safer course, and to describe it as distinct. According to Carpenter, Kitchen Parker and Rupert Jones, all the various "specifically distinct" forms described as belonging to the subgenus (or genus), *Nummulina*, of which, up to 1853, 55 were recognized by D'Archiac and Haime, are referable to a single species, which is consequently co-extensive with the genus (Carpenter, "Introduction to the study of the Foraminifera," Roy Soc. Rep., 1862, pp. 273–4).

[2] Nummulites are excessively rare in deposits newer (miocene or pliocene) than the oligocene.

the fragments that have been placed at my disposal—with very few exceptions all the molluscan remains belong to a period much more recent than the eocene, and to species that are still living at the present day. And what may appear still more singular, they are referable in principal part to land and fresh-water genera—*Glandina*, *Paludina*, *Ampullaria*.[1] From this association, and the circumstance that Nummulites are still met with in existing seas,[2] it might readily be inferred that there has been here a co-mingling of contemporaneous marine and fresh-water organisms, and that the deposits in question were laid down under such conditions—proximity to the mouth of a river—where a co-mingling of this kind could take place. Indeed, it would be difficult from paleontological evidence alone to disprove such an assumption, were it not that almost incontrovertible proof to the contrary in addition to that furnished by the *abundance* of Nummulites, is afforded in the presence of the remains of *Orbitoides*,[3] a genus which attained its greatest development in the upper eocene ("Nummulitic") and oligocene periods, and which does not appear to have survived the miocene. There can, therefore, be little or no doubt that the rock fragments marked by this admixture of an older and newer (post-pliocene or recent) fauna, and comprising both marine and fresh-water types of organisms, have derived their faunal characters in great part from the deposits of a more ancient formation, which formation represents, and is the equivalent of a portion of the European "Nummulitic" (whether eocene or oligocene).

precise position which the formation holds in the nummulitic scale as fixed by Hantken or La Harpe (*Étude sur les Nummulites du Comté de Nice*, Bull. de la Soc. Vaud. des Sc. Nat., vol. XVI., pp. 223–4, 1879), cannot be positively determined from our present data, since exceptionally the group of the *Nummulites plicatæ* is represented as well in the oldest as in the newest of the tertiary deposits marked by the members of this class of organisms.

FIGURES. *Nummulites Willcoxi.*
1, Natural size ; 2, Same, enlarged.

ON SUPPOSED TERTIARY AMMONITES.

BY J. S. NEWBERRY.

In the last issue of the Proceedings of the Academy of Natural Sciences (1882, Part 1, p. 94), Prof. Heilprin announces the discovery of Ammonites in rocks of tertiary age, viz.: the Tejon group of California.

Inasmuch as the verification of this statement would abrogate one of the most important distinctions between the cretaceous and tertiary fauna, I would ask Prof. Heilprin to reconsider his conclusion and review carefully the accessible facts bearing on the case. Undoubtedly the succession of living organisms on the earth has been unbroken, and somewhere there are connecting links between the faunas of all the different geological systems. A scheme of geological classification is, however, not only a convenience, but a necessity, and that at present in general use has been established by such an amount of concurrent testimony that modifications of it should only be accepted on the most undoubted evidence. The question of the age of the Tejon and Chico groups of California is not a new one. In 1855 Dr. Trask made the announcement in the first volume of the Proceedings of the California Academy of Sciences, now repeated by Prof. Heilprin, that is, the discovery of Ammonites in tertiary rocks. These he con- [redacted]

any other paleontologist, Mr. Gabb was decided in his ce of the Tejon group to the cretaceous system. The l which Mr. Conrad had on which to base an opinion was mndant, but it was sufficient to satisfy him that his original cation of the rocks in question was erroneous. I would re ask in the interest of geological truth, that Prof. Heil- ould give to a question so important as this, very full ration, and, if possible, make a study of the facts in the efore discarding the conclusions of Prof. Whitney, Mr. Mr. Conrad, and Mr. Meek.

ON THE AGE OF THE TEJON ROCKS OF CALIFORNIA, AND THE OCCURRENCE OF AMMONITIC REMAINS IN TERTIARY DEPOSITS.

BY ANGELO HEILPRIN.

The controversy which for a long time was maintained between Conrad and Gabb as to the age of the Tejon rocks of California, referred by the former to the eocene series, and by the latter considered to represent the uppermost member of the cretaceous (Division B of the California Report), can scarcely be considered to have settled the question at issue.[1] Both paleontologists appear to have maintained their respective positions to the last, and to have permitted no considerations to outweigh the mass of proof that at the same time was bearing in both directions.[2] The essence of Conrad's views briefly stated is: That a portion of the rocks, that of Cañada de las Uvas, included in the cretaceous, fails "to show one cretaceous fossil," whereas, on the contrary, it is held to contain at least two representative, and at the same time highly characteric tertiary forms—"*Venericardia planicosta* and *Aturia zic-zac*;" and that, where in other deposits referred to the same horizon, an association between tertiary and cretaceous species obtains, such an association has been brought about as the result of the breaking up of the materials of an older formation, and the mixing up of their contained remains with [redacted]

The most elaborate defense of Gabb's position is that published in the "Proceedings" of the California Academy of Natural Sciences for 1867 (pp. 301–6), in a paper entitled "On the Subdivisions of the Cretaceous Formation in California." In this paper the author essays to show, by means of comparative tables, the close relation that exists between the faunal characters of the upper and lower members of his cretaceous group (Divisions B and A of the California Report), and to prove by this relationship the fallaciousness of a classification that would relegate the deposits of the group to two distinct eras in geological chronology. The following table of organic remains representing the fauna of the Tejon group (Division B), with the various localities of their occurrence, is there appended:[1]

	Upper Division (B)	Intermediate Beds.	Lower Divisions and Remarks.
Calianassa Stimpsonii,	C.T.		Chico.
Aturia Mathewsonii,	M.C.T.		Martiñez.
Nautilus Texanus,	C.		Shasta Co.
Ammonites, n. s.,	C.M.		Curry's; Benicia; Martiñez.
Typhis antiquus,	M.T.		
Fusus Martinez,	M.T.		
F. Mathewsonii,	M.C.		Curry's.
F. Diaboli,	C.		
F. aratus,	M.		
F. Californicus,	C.T.	LL.	
Hemifusus Hornii,	T.		
H. Cooperii,	C.D.		
H. Remondii,	M.C.T.G.		
? Neptunea supraplicata,	C.D.		
N. gracilis,	M.		
Perissolax brevirostris,		LL.	Many localities.
P. Blakei,	M.C.T.		
Turris Claytonensis,	C.T.		
T. varicostata,	C.		(*Varicostata* by error in Rep.)
Cordiera microptygma,	T.		
Tritonium Hornii,	C.T.		

[1] A few species occurring in beds said to be intermediate between B and A, but not properly belonging to the Tejon Group, are here included. In addition to the 107 (112, inclusive of those from the "intermediate" beds) species enumerated in the list, a small number of other forms have been described in vol. II (1869) of the "Palæontology" of the California Survey. The different localities in the above table are designated by letters, as follows: M, Martiñez; C, Clayton to Marsh's, T, vicinity of Fort Tejon; G, a locality 10 miles west of Griswold's, near New Idria; I, New Idria; D, San Diego; LL, Lower Lake Village, 1 mile southeast of the town.

	Upper Division (B).	Intermediate Beds.	Lower Divisions and Remar
T. Diegoensis,	D.		
T. paucivaricatum,	T.		
T. Whitneyi,	T.D.		
Buccinum liratum,	M.	LL.	
Nassa cretacea,	M.T.G.		
Pseudoliva lineata,	M.		
P. volutæformis,	T.		
Olivella Mathewsonii,	M.T.G.C.		
Ancillaria elongata,	C.D.		
Fasciolaria læviuscula,	C.	LL.	
F. sinuata,	T.D.		
F. Io,	T.		
Mitra cretacea,	M.		
Whitneya ficus,	T.		
Ficus mamillatus,	T.		
Natica Uvasana,	T.		
Lunatia Shumardiana,		LL.	Martiñez and elsewhe
L. Hornii,	T.		
L. nuciformis,	C. T.(D. ?)		
Gyrodes expansa,		LL.	Almost everywhere.
Neverita secta,	T.		
N., n. s.,	G.I.		
Naticina obliqua,	M.T.		
Amauropsis alveata,	M.C.T.G.D.	LL.	Curry's; S. of Mt. Dia
Morio tuberculatus,	M.T.C.G.D.		
Scalaria (Opalia) Mathewsonii	M.		
Niso polita,	M. T.		
Cerithiopsis alternata,	M.C.		
Architectonica cognata,	M.C.T.		
A. Hornii,	T.		
Margaritella crenulata,	D.		
Conus Remondii,	M.C.T.D.		
C. Hornii,	T.		
C. sinuatus,	T.		
Rimella canalifera,	M.T.		
R. simplex,	C.D.		
Aporrhais angulata,	M.		
Cypræa Bayerquei,	M.C.		
Turritella Uvasana,	M.C.T.G.		
T. Saffordii,		LL.	M. and Solano Co.
T. infragranulata,	M.		
Galerus excentricus,	M.C.T.D.I.	LL.	
Spirocrypta pileum,	T.I.	LL.	
Gadus pusillus,	M.T.		
Dentalium Cooperii,	M.D.		Curry's; S.of Mt. Di
D. stramineum,	M.D.		Curry's; S.of Mt. Di
Bulla Hornii,	T.		
Cylichna costata,	M.C.T.D.		M.; Texas Flat and r [other local
Megistostoma striata,	M.		
Martesia clausa,	G.		Pence's; Texas Flat
Solen parallelus,	M.C.T.		
Solena Diegoensis,	D.		
Corbula Hornii,	T.		

	Upper Division (B).	Intermediate Beds.	Lower Divisions and Remarks.
C. parilis,	G.M.D.		
Neæra dolabræformis,	M.		
Mactra Ashburnerii,	M.C.T.		Nearly everywhere in [both Divisions.
Gari texta,	M.		
Tellina longa,	M.C.T.		
T. Remondii,	C.T.		
T. Hoffmaniana,	G.		M.; Pence's, and else- [where.
T. Hornii,	T.		
T. Californica,	C.T.		
Meretrix Uvasana,	M.C.T.I.G.		
M. Hornii,	T. [D.		
M. ovalis,	T.		
Dosinia elevata,*	T.		
D. gyrata,	M.C.T.G.		
Tapes Conradiana,	G.M.T.	LL.	
T. quadrata,	M.T.		
Cardium Cooperii,	M.T.D.		
C. Brewerii,	M.C.T.G.		
Cardita Hornii,	M.C.T.I.G.		
Lucina cumulata,	T.		
L. cretacea,	C.		
Mysia polita,	M.C.I.		
Crassatella grandis,	M.T.	LL.	
C. Uvasana,	T.		
Mytilus ascia,	T.		
Modiola ornata,	M.C.T.I.		
Septifer dichotomus,	T.		
Crenella concentrica,	M.		
Avicula pellucida,	M.G.	LL.	S. Louis Gonzaga.
Arca Hornii,	T.		
Cucullæa Mathewsonii,	C.	LL.	M.
Barbatia Morsei,	D.		
Axinæa sagittata,	M.T.G.		
A. Veatchii,		LL.	M.; Tuscan Springs, etc.
Nucula (Acila) truncata,	M.T.		Everywhere.
Leda protexta,	M.C.T.G.		M.
Placunanomia inornata,	D.		
Flabellum Remondianum,	C.		

Of the total number of 112 species here enumerated, 105 are recorded as being found in Division B (Tejon group), 15 in the so-called "intermediate beds," and 21 in various deposits of the lower group (Division A). The number of forms held in common by Divisions A and B, as is shown by the above table, and the intimate faunal relations which the "intermediate beds" hold to the deposits supposed to lie above and below them, it is claimed demonstrate conclusively that the series is a continuous one, and admits of no such separation as had been insisted upon by Conrad.

The value of a comparative table, such as is here presented,

naturally depends upon the accuracy of its details; whether in the present instance this accuracy is such as to entitle the table to special consideration, remains to be seen. On page 302 of the paper last referred to Mr. Gabb states: "Of 280 species of fossils recognized and named in the Californian cretaceous rocks, 107 are found in this upper member. Of these, 84 are peculiar, and *23 are found in common between undoubted members of this group and undoubted members of the older group.*" The inaccuracy of this last assertion will be readily manifest when an appeal is made to the data afforded by the preceding table.[1] It will be seen that here only 16 species are enumerated whose range comprises the "undoubted members" of both the older and newer groups (A and B), as follows:

Callianassa Stimpsonii,	Cylichna costata,
Aturia Mathewsonii,	Martesia clausa,
Nautilus Texanus,	Mactra Ashburnerii,
Ammonites, n. s.,	Tellina Hoffmanniana,
Fusus Mathewsonii,	Avicula pellucida,
Amauropsis alveata,	Cucullæa Mathewsonii,
Dentalium Cooperii,	Nucula (Acila) truncata,
D. stramineum,	Leda protexta.

But in glancing over the original descriptions of the species here cited, as given in vol. I of the Palæontological Report, and the more recent list of distribution published in vol. II, we find—

1. Vol. I, p. 59, that all the specimens (4) of *Nautilus Texanus* were obtained from Division A (older group), no reference being there made of its occurrence in any deposit of newer date; nor is any mention of the species being found in Division B made in the more recent list of distribution (p. 209) contained in vol. II of the Report (1869). In vol. II of the "American Journal of Conchology" (p. 88) the species is quoted from Clayton (B), but Mr. Gabb has here evidently confounded the name of a finder ("the last was found by Mr. Clayton") with that of the locality.

[1] Mr. Gabb has here evidently included the "intermediate beds" among the "undoubted members of the older group," and yet to disclaim any intention on his part for so doing, he adds (immediately following the sentence above quoted): "Besides this, I was fortunate enough to discover a locality near Clear Lake, this fall, where, within a space of two feet, I found an admixture of upper and lower forms, proving the existence of a transitionary bed, or, perhaps, group of beds." In justice to Mr. Gabb, it must be stated, that on p. 305 of the same paper, only 16 species, a figure more nearly the correct one, are stated to be common to Divisions A and B

2. Vol. I, p. 195, no indication is given of the occurrence of *Cucullæa Mathewsonii* in deposits belonging to Division B, although the locality Martiñez, where beds representing both B and A are to be met with, is given. From this indefinite statement it might be inferred that the specimens were obtained from the upper beds, but any doubt on this point is set at rest by the subsequent reference (Amer. Journ. Conchol. II, p. 88; Cal. Pal. Rept., II, p. 249) of these Martiñez beds to the Martiñez group (A). The second locality given (for a single specimen) is "Clayton, *below*[1] the coal-veins," which in vol. II of the Report (*loc. cit.*) is referred to the "intermediate beds."

So that deducting these two forms which have not yet been detected in the deposits of Division B, these last have at the utmost (at least as far as is known), only 14 species common to the lower Division (A), instead of 23 as claimed.

But while 14 species *may* actually be held in common by the upper and lower members, we are far from satisfied that such really *is* the case. Thus Mr. Gabb states (Pal. Report, I, p. 153) that *Mactra Ashburnerii* "is one of the most common fossils in the State," and instances numerous localities of its occurrence in both divisions A and B; and further (in Am. J. Conchol., II, p. 88), that it is found in "almost every locality of both Divisions." It would certainly be a difficult matter to disprove such an affirmation, but it is, to say the least, surprising, that a careful examination of all the specimens of the Gabb collection in the possession of the Academy of Natural Sciences, which have served as the basis of the Palæontological Report, and which comprise probably the greater number, if not nearly all, of the cretaceous "types" and figured specimens, we have failed to discover a single fragment from Division A (Martiñez, Chico, and Shasta groups) that could with any amount of positiveness, or with anything more than considerable doubt, be referred to the form that under the same name is credited to Division B (Tejon group). This is the more singular since the collection embraces a very considerable number of rock fragments, which are crowded with molluscan remains. Two specimens marked in Gabb's handwriting as coming from Texas Flat (Chico group, A), and considered by that paleontologist to represent the "typical form"

[1] The italics appearing in the quotations belong to the writer of this article.

(so marked) of the species, differ very essentially in outline from the Tejon specimens, and are doubtless specifically distinct. Again, in the case of *Nucula truncata* Mr. Gabb instances (Pal. Rept., I, p. 199) several localities of its occurrence in Division A, and also Martiñez as a locality of Division B, but no mention is made of the last named as a locality of the first Division. On the other hand, *all the Martiñez specimens of this species in the Gabb collection are marked as belonging to Division A!* In vol. II (p. 197) of the Reports, however, we are informed that this species is "found at almost every locality of the Chico, Martiñez, and Tajon groups," but we must confess that, after a diligent search, we have failed to discover among the Tejon rock fragments anything that could with sufficient evidence be referred to this form. Nor have we been able to find the faintest traces of *Leda Gabbii* (*protexta* of Gabb) (or for that matter, of several other forms belonging to group B) in the rock fragments obtained from the older members, but it would perhaps be premature to conclude from this that it may not really occur there. On page 199 of vol. I, the only locality given for Division A is (near) Martiñez (at the same time a locality for Division B), but in the "tabular statement" appended to the same volume (p. 235) the ranch of San Luis Gonzaga is substituted instead. *Tellina Hoffmanniana* is not stated in the original description (vol. I, p. 156) to be found in any locality of Division B, nor is it included in the

[redacted]

amination of the preceding table will show that 7 species, not found in deposits older than the intermediate beds, are credited as being common to these last and the Tejon group, as follows :—

Fusus Californicus,	Spirocrypta pileum,
Buccinum liratum,	Tapes Conradiana,
Fasciolaria læviuscula,	Crassatella grandis.
Galerus excentricus,	

These are said to be associated with a limited number of forms that are found in the lower division, but which do not pass above, and (if we except *Cucullæa Mathewsonii*, which has been shown *not* to belong to the upper member) with only one *solitary* form, *Avicula pellucida*, that is common to both divisions, a circumstance of suspicious import. But in turning to the original description of *Fasciolaria læviuscula* (vol. I, p. 101) we find no mention of its being found in deposits belonging to Division B, but on the contrary, it is distinctly stated to have been "found in the strata immediately *below* the coal in the Mount Diablo district" (although it was *associated* with several species found also at San Diego and Martiñez of Division B), and in vol. II of the Report (p. 220), *only* the "beds intermediate between the Martinez and Tejon groups" are given as the locality of its occurrence. Nor do we find in the lists of distribution contained in vol. II[1] any mention of the "intermediate beds" in the case either of *Buccinum (Brachysphingus) liratum*, *Galerus excentricus*, or *Spirocrypta pileum*, although it does occur in the case of the remaining three (*Fusus Californicus*, *Tapes Conradiana*, and *Crassatella grandis*).

We believe it may be fairly questioned, from what has already been shown, whether Mr. Gabb's tables afford *at all* a safe criterion upon which to base the solution of the problem at issue. The numerous discrepancies would seem to prove almost conclusively that in their preparation the author was in a measure, or even to considerable part, borrowing from his memory, or, at any rate, not absolutely from the data that were presented in the field. But granting that the tables be entirely trustworthy in the statements that have been called into account, do they at all prove his case?

[1] Published more than one year *after* the paper in the "Proceedings of the California Academy, and therefore at a time when Mr. Gabb ought to have been fully cognizant of the value and position of his intermediate beds.

We believe most assuredly not. Surely a geologist would find it difficult, on the assumption of immediate continuity and without the assistance of a change in the general character (whether marine, fluviatile, or terrestrial) of the fauna, to account for the rather anomalous circumstance, that, in a locality rich in organic remains, the upper member of a closely connected series should be characterized by a fauna about 80 per cent.[1] of whose individual forms is peculiar to itself. In order to antagonize this difficulty, and, at the same time, to show still more effectively how much more closely the members of this upper group of deposits are linked to the beds below them (and, consequently, how indisputably cretaceous) than to those following (and, therefore, how little tertiary), Mr. Gabb submits the argument (Proc. Cal. Acad. Nat. Sciences, 1867, p. 306; A. J. Science, new ser., vol. XLIV, p. 229), that "All of the species are peculiar to this group (B), or to this and *underlying*[2] rocks; *not one* has been found associated either with living forms, or with species known to occur in the recognized tertiaries of California. Five of the genera are peculiar to the secondary. An Ammonite ranges entirely through the group to the top of the highest fossiliferous strata. The genera *Perissolax*, *Gyrodes*, *Margaritella*, and the sub-genus *Anchura*, of the genus *Aporrhais*, are all recognized as strictly characteristic of the cretaceous; so much so, that the presence of a single undoubted representative of either of these genera would be [redacted]

Turrilites, *Crioceras*, ? *Ptychoceras* (*Helicancylus*), *Baculites*, *Inoceramus*, *Trigonia*, *Gryphæa*, and *Exogyra*, which are found in one or other, or several of the deposits of the older group (A), are here completely wanting. Surely the wholesale appearance and disappearance of characteristic genera have *at least* as much import in the determination of geological chronology, or in the fixing of systemic relationships, as the casual persistence of a few specific types, and, indeed, a paleontologist or zoologist would be very bold to assert that the distinctive characters of a fauna depend rather upon the features drawn from its specific, than from its generic constituents.[1] It would appear strange, to say the least, if a geologist were now to unite the Devonian and carboniferous formations, or the Silurian and Devonian, for no other reason than that they comprise in their several faunas a number of "common" forms, when the general facies of these faunas is very distinct.[2]

[1] Accepting the generic determinations of Mr. Gabb, we find that of about 77 genera credited as belonging to the Tejon group, no less than 33 (or 43 per cent.) have *not* been described from the cretaceous deposits underlying this group; and 8 additional ones do not pass beyond the "intermediate beds!" The faunas are here, then, decidedly *very* distinct, despite the fact that a limited number of "common" or passage forms (forming at the utmost only about 13 per cent. of the Tejon fauna) may be said to exist.

[2] According to Etheridge (Anniversary Address, London Geol. Soc., 1881 —Quart. Journ. Geol. Soc., pp. 184–185), of 37 species of brachiopods occurring in the upper British Devonian, 16 pass into the succeeding carboniferous deposits; these last also hold 5 species of upper Devonian lamellibranchs, 5 gasteropods, 2 heteropods, and 4 species of the genus *Orthoceras*. Of the total number of 183 genera and 526 species constituting the British Devonian fauna, 30 genera and 49 species pass into the carboniferous (*loc. cit.*, p. 197). In California, of about 141 genera described from Division A (Martiñez, Chico, and Shasta groups), 44 are also found in Division B (Tejon group), and, therefore, the proportion of generic forms common to what is here claimed to be both cretaceous and tertiary is greater than that which obtains in the case of the British Devonian and carboniferous formations. But if in both instances only the molluscan fauna (which comprises, with the exception of 5 species, all of Gabb's described forms) is taken into account, a very striking correspondence in the numerical proportions presents itself. Thus, according to Etheridge's tables, 25 out of the 74 Devonian molluscan genera appear in the carboniferous deposits, or nearly 34 per cent.; in California, 40 of the 133 Division A genera are also represented in Division B, or 30 per cent. According to

But it is here maintained, that in addition to a purely specific relationship we have one established through generic ties. "An Ammonite ranges entirely through the group to the top of the highest fossiliferous strata. The genera *Perissolax*, *Gyrodes*, *Margaritella*, and the sub-genus *Anchura*, of the genus *Aporrhais*, are all recognized as strictly characteristic of the cretaceous; so much so, that the presence of a single undoubted representative of either of these genera would be strong presumptive evidence of the cretaceous age of any rocks in which it might be found" (Proc. Cal. Acad., p. 306). Laying aside for the present the question of the Ammonite, only a few words need be said respecting the other genera.[1] As Mr. Conrad has already shown (A. J. Science, new ser., xliv, p. 376), no locality in Division B is assigned to the (2) species of *Gyrodes* in vol. i, of the report, but on the contrary, both are clearly assigned to the Division A; and

Mr. Etheridge (*loc. cit.*, p. 179), 12 genera (of 137), and 20 species (of 392), of Ludlow (upper Silurian) fossils pass into the Devonian; and 11 genera (of 61), and 16 species (of 182) from the Cambrian into the Silurian (Arenig) (p. 100).—The circumstance that the faunal break between the cretaceous and tertiary periods is in all, or nearly all, localities thus far studied greater than between the Devonian and carboniferous or the Silurian and Devonian, has no bearing on the point at issue, since a connection or passage must exist somewhere, and it is quite immaterial where this passage may be found. The assertion that has at various times been repeated that no cretaceous species have been known to pass beyond the

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in vol. ii (p. 222) the transition beds are given as the upper limit of the genus. In the case of the genus (or sub-genus) *Anchura*, the species especially referred to, *A.* (*Aporrhais*) *angulata*, is stated (vol. i, p. 128) to occur very sparingly near Martiñez "in a single stratum of greenish-gray limestone," and is credited *exclusively* to Division B; yet, in the same description, a locality in Division A—Cottonwood Creek, Shasta County—is mentioned! Furthermore, in the "tabular statement" appended to the same volume (p. 227), the Martiñez locality of the identical species is referred to Division A! In vol. ii (p. 226), while the localities are given, the group has been wisely omitted. As to the forms that have been referred to *Perissolax*, it would be very difficult to state why they should be considered as being characteristically cretaceous. It is true that the genus was founded on cretaceous species,[1] but it would be, indeed, a very comprehensive genus that would embrace such entirely dissimilar forms as the *Pyrula* (*Fusus*) *longirostra* of D'Orbigny,[2] one of the types of the genus, and the *P. Blakei* (*Busycon? Blakei* of Conrad) and *P. brevirostris* that are here referred to it (and also the *Fusus Durvillei* and *F. Hombroniana!*).[3] There is, as far as we are aware, not the faintest reason for considering the California species here indicated as representing cretaceous molluscan types, whatever may be thought of the genus *Perissolax* as originally founded; on the contrary, as Conrad has pointed out (A. J. Science, new ser., xliv, p. 376), they more properly belong to his genus *Levifusus* (sub-genus? of *Fusus*), represented in the eocene of Alabama by the *Fusus trabeatus* (*F. bicarinatus* of Lea, young).

Respecting the forms that have been referred to *Margaritella*, and to their being "strictly characteristic of the cretaceous," it need only be stated that Mr. Meek, the author of the aforesaid

[1] Gabb, Proc. Am. Philos. Soc., 1861, p. 66.

[2] *Paléont. de l'Amér. mér.*, p. 119, pl. 12, fig. 13.

[3] D'Orbigny, *Voyage de l'Astrolabe et de la Zélée*, pl. 2, fig. 1, and pl. 1, fig. 31. . . . Gabb, Proc. Amer. Philos. Soc., 1861, p. 67. It can scarcely be wondered at that neither Conrad nor Stoliczka could grasp the characters of the genus, and that the latter referred the typical form not only to a distinct genus, but to a very different family, the *Purpuridæ* (Palæontologia Indica, Cretaceous Fauna, II, p. 149).

genus, distinctly affirms[1] that they do *not* belong where they have been placed, but in the genus *Solariella* of Wood, which was founded on a tertiary (pliocene) fossil, *S.* (*Margarita?*) *maculata* from the British Coralline Crag.[2]

So far, therefore, not one of Gabb's characteristic cretaceous genera, with the exception of the Ammonite, of which several specimens are said to have been found in the rocks of the Tejon group (and of which, or of an allied genus of the *Ammonitidæ*,[3] the author of this article was fortunate enough to discover a solitary fragment), carries out the inference that has been drawn from their actual or supposed existence.

Having thus, as we believe, satisfactorily shown the erroneousness of many or most of the data that have served as a guide in the classification of the rocks in question, and to their reference to the cretaceous period, it now remains to examine in greater detail the reasons why these should be considered as *not* cretaceous, but tertiary. Briefly repeating what has already been said, we find that the Tejon fauna (considered solely with respect to the other California faunas) comprises about (and *probably considerably more than*) 80 per cent. of forms peculiar to itself, or at least that are not found in deposits representing a lower horizon; that 33 out of its 77 genera, constituting 43 per cent. of the entire number, are likewise not represented in the older deposits; that with the exception of a few fragments or specimens (about 7 in all) of one or two forms of *Ammonitidæ*, there is a complete absence of distinctively cretaceous organic types (while they are sufficiently plentiful in the subjacent beds); and finally, that there is a sudden introduction of new molluscan types, most of which are but barely, if at all represented in the cretaceous deposits of the world (as far as has yet been determined), and several of which are not known to have preceded the tertiary period. The appearance here for the first time of the genera *Ancillaria*, *Bulla*, *Conus*, *Crepidula*, *Cassidaria*, *Cypræa*, *Ficus*, *Gadus*, *Mitra*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Pseudoliva*, *Rimella*, *Triton*, *Trochita*,

[1] U. S. Geol. Survey of the Territories, ix, Invertebrate Palæontology, pp. 301–2, 1876.

[2] Catalogue of Crag Mollusca, Ann. Mag. Nat. Hist., ix, 1842, p. 531; "British Crag Mollusca" (Palæont. Soc. Rep., 1848), i, p. 134.

[3] The fragment was too imperfect to admit of positive generic determination.

and *Typhis*[1] has already been adverted to. But these are not the

[1] The writer is unaware that any unequivocal species of the genera *Ficus* (*Sycotypus*; *Pyrula*, as restricted), *Gadus*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Rimella*, or *Typhis*, have been described from deposits antedating the tertiary.

Pyrula Pondicherriensis of Forbes (Trans. Lond. Geol. Soc., vii, p. 127, 1846; *Pyrula Carolina* of D'Orbigny, Voy. Astrolabe et Zélée, Pal. pl. 11, figs. 34 and 35), a ficuliform species from the cretaceous deposits of India, has been shown by Stoliczka to belong to the *Volutidæ*, and to a new genus, *Ficulopsis* (Pal. Indica, Cretac. Fauna, ii, pp. 84–5).

Nassa lineata of Sowerby (Fitton's Report, Trans. Lond. Geol. Soc., 2d ser., iv, p. 344, pl. xviii, p. 25), from the Blackdown sands, may be a true member of the genus to which it is referred, but neither the figure nor description of the species permits of such a determination. The second species described in the same report, *N. costellata*, has been referred by D'Orbigny, Pictet, and Stoliczka to *Cerithium*. The first of these is the only cretaceous species recognized by Pictet and Campiche (*Materiaux p. l. Paléont. Suisse*, iii ser., p. 673) as being probably a *Nassa*, but the author's conclusions on this point appear to have been based entirely upon Sowerby's original determination. Stoliczka (*op. cit.*, p. 143) places *Buccinum Steiningeri* of Müller (*Petr. Aach. Kreidef.*, p. 78, 1851), an unfigured species from the chalk of Aix-la-Chapelle, in *Nassa*, but on what authority or for what reasons, this reference is made, we have found it impossible to discover. The two species of *Nassa* described by the last named author from the cretaceous Arrialoor group of India, *N. Vylapaudensis* and *N. Arrialoorensis*, and determined from imperfect specimens, are at best but very doubtful, and, indeed, it is stated that the last may possibly be a *Mangelia* or *Defrancia* (*op. cit.*, p. 145)!

Niso Nerea of Deslongchamps (*Bull. Soc. Linn. Norm.*, 1860, v. p. 126; *Turbo Nerea* of D'Orbigny, *Pal. Franc. Terr. Jur.*, pl. CCCXXVI, figs. 4 and 5) considered by Stoliczka (op. cit., p. 288) to be possibly referable to one of the subgenera of *Niso*, does not appear to have much, if anything, in common with that genus; nor can much more be said in favor of the other species (*Turbo, Trochus*, etc.) referred by Deslongchamps to the same genus.

Oliva vetusta of Forbes (Trans. Lond. Geol. Soc., 2d ser., VII, p. 134, pl. 12, fig. 23), from the cretaceous rocks of Southern India, is a *Dipsacus* according to Stoliczka (Pal. Indica, Cret. Fauna, II, p. 452, pl. XXVIII, fig. 27). The *Oliva? prisca* of Binkhorst (*Monogr. Gastr. et Ceph. Craie sup. de Limbourg*, 1861, p. 71, pl. Va[2], fig. 14) is unrecognizable as a member of the genus to which it is referred, and, according to the author himself, may possibly be a fragment of a *Cypræa*.

Of the genera *Pseudoliva* and *Ancillaria* it would appear that only a single cretaceous species of each has thus far been recognized; the *P. subcostata* of Stoliczka (*op. cit.*, p. 145) (from the Arrialoor group of Southern India), described from a solitary imperfect specimen, and the *A.*

only more or less strictly tertiary genera that are here represented. In the *Tritonium paucivaricatum* (Palæont. Calif., I, p. 95, figs. 209, 209a, very badly figured) we have a true *Cancellaria!* The *Megistostoma* (new genus[1]) *striata* (I, p. 144) is a true *Bullæa*, a genus represented by a very limited number of fossil forms, and so far not known to have appeared before the tertiary period. *Naticina obliqua* (I, p. 109) appears more like a *Sigaretus*, the shell (in the specimens examined, all of which are partially imbedded in the matrix) being considerably more depressed than in the genus *Naticina*. But to whichever of these two genera the species may belong, it is immaterial in the present consideration, since no unequivocal member of either form, as far as the writer is aware, has been described from any formation older than the tertiary.[2] In vol. II of the Report (p. 157) we have described a member of the genus *Bullia* (sub-genus *Molopo-*

cretacea of Müller (*Monogr. Petr. Aach. Kreidef.*, p. 79, pl. 6, fig. 23), from the chalk of Aix-la-Chapelle, and described from a single imperfect impression. The least equivocal of the several doubtful cretaceous forms that have been referred to the genus *Conus* is probably the *C. Marticensis* of Matheron (*Cat. des Corps organisés fossiles, Bouches-du-Rhone*, 1842, p. 257. pl. 40, figs. 24–25), from the chalk of Martigues. There seems to be no reason for specially doubting that the imperfect specimen here figured is a true cone, but yet it would be by no means surprising if closer examination would prove it to be a form more closely related to *Acteonella* or *Acteonina*. The *C. tuberculatus* of Dujardin (*Mém. Soc. Geól. de France*,

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phorus, doubtfully different from the tertiary and recent genus, or sub-genus, *Buccinanops*); and finally (*Ibid.*, p. 162), a *Terebra* (*T. Californica*), a genus whose range has not yet positively been determined to extend back beyond the limits of the Tertiary period.

So that of the 77 genera represented in the Tejon group, at the very least 22 are more or less distinctively[1] tertiary; and of these 22, 11 are not positively known to have appeared before that epoch of geological time. On the other hand, if we except the six or seven fragments of *Ammonitidæ* (one, or possibly two genera) already referred to, there would seem to be in the entire number *not a single distinctively cretaceous generic type!*

EVIDENCE AFFORDED BY SPECIFIC FORMS.

The circumstance, considering the deposits here referred to to be eocene, that "not one [species] has been found associated either with living forms, or with species known to occur in the recognized tertiaries [miocene and pliocene] of California" (Gabb, Proc. Calif. Acad. Nat. Sciences, 1867, p. 306), is not very surprising. The number of species that pass from the deposits of eocene age into the miocene is frequently very limited, or there may not be a single one. This last is, singularly enough, what obtains in the case of the tertiaries of the eastern and southern United Stated, where both the eocene and miocene formations are extensively developed, and where the organic remains are also very abundant.[2]

Leaving aside the question of identity as existing between the eocene and miocene forms, it will be important to ascertain what correspondence, if any, manifests itself between the specific types of the deposits here discussed, and those of other tertiary (eocene) localities; for the determination of this point we subjoin the following notes on a few of the species:

Cardita Hornii and Cardita planicosta.—Whether the species of *Cardita* described by Conrad from the rock of Cañada de las Uvas as *C. planicosta* (Pacific R. R. Reports, V, p. 321), and designated by him as the "finger post of the eocene" (*Ibid.*, p. 318), is the veritable *C. planicosta* of Lamarck, or not, it is impossible to state. The author's intimate acquaintance with that species, from both European and American

[1] But sparsely, if at all, indicated in the earlier deposits.

[2] It would be, perhaps, going too far to state, that not a single species is held in common by these eocene and miocene deposits; it would be more proper to say, that none such has yet been recognized.

forms, ought certainly to have enabled him, in the presence of fairly preserved specimens, to determine this point definitely, but whether the specimens in question were actually in a condition to admit of such positive determination, can, at the present time, only be conjectured. The description accords well with the species (and in a measure, also, the figure), but it is a little too brief to admit of a positive conclusion being drawn therefrom. For a similar reason it would be impossible to affirm conclusively whether the species is, or is not the *C. Hornii* of Gabb (Palæont. Calif., I, p. 174; II, p. 188), specimens of which were found near the same locality. I believe there can be no doubt that the character pointed out by Gabb (II, p. 188), as distinguishing the two species here mentioned—namely, the form of the ribs, which are rounded in the one (*C. Hornii*), and flattened in the other (*C. planicosta*)—has a certain value, but whether sufficient to permit of specific distinctions being based upon it in the absence of all other characters, can only be determined when a greater number of perfect specimens will have been brought together for comparison. In all other respects the two species appear to be identical, as will be seen from the following (Gabb's) statement: "I have compared my specimens with shells from the London clay, and from the Alabama eocene, and find that, except in the extreme quadrate forms,[1] they are absolutely identical in all characters save one. The hinges are so similar that I despair of making an intelligible written description of their minute differences, and should hardly feel willing to trust an artist with their delineation." Granting the specific value of the character claimed by the aforesaid paleontologist, the type (*C. Hornii*) still remains distinctively tertiary,[2] since what may be considered as analogous forms, are to the knowledge of the writer, completely wanting (although the genus is already represented) in the pre-tertiary deposits.

Dosinia elevata (I, p. 167) is more likely, as stated by Conrad, to be a *Dosiniopsis* than *Dosinia* (Am. J. Conchol., II, p. 98), despite the assurances of Mr. Gabb to the contrary (*Ibid.*, p. 91).[3] As much as can be determined from the figured specimen it appears to be very closely allied to the *Dosiniopsis Meekii* of Conrad (*Cytherea lenticularis?* of Rogers), from the lower eocene of Maryland and Virginia, from which it mainly (or barely) differs in the greater width of the flattened area on the

Tritonium pauciväricatum (I, p. 95, pl. 28, figs. 209, 209a, unrecognizably figured), as has already been stated, is a *Cancellaria*, and a form so closely related to the *C. evulsa*[1] of Brander ("Fossilia Hantoniensia," 1766, p. 14, as *Buccinum*; pl. 1, fig. 14), from the British Bartonian (upper eocene), that it may well be doubted whether it is at all specifically distinct; and the same may be said of its relation to a form[2] from the lower eocene deposits of Clarke County, Ala., which is doubtfully referable to the *C. tortiplica* of Conrad.

Megistostoma striata (I. p. 144, pl. 21, figs. 108a, b).—While, perhaps, from the slightly imperfect condition of the specimen, it would be impossible to affirm positively that this species is identical with the *Bullæa expansa* of Dixon, from the eocene of Brackelsham, England, and the Paris basin (Deshayes, *Animaux sans Vertebres, Bassin de Paris*, II, p. 652, pl. 36, figs. 27–30, *Mollusques Cephales*), yet, what there is of it shows absolutely no character by which to distinguish it from that species.

Conclusion.

We believe it has been satisfactorily shown from what has preceded, that the rocks of the Tejon group (cretaceous Div. B. of the California survey), despite their comprising in their contained faunas a limited number of forms[3] from the subjacent

[1] Compared with actual specimens.

[2] Kindly transmitted for examination, with other fossils, by Dr. Eugene A. Smith, State Geologist of Alabama.

[3] The reliance that is to be placed upon Gabb's *positive* assertions as to the localities or horizons whence certain species have been obtained, may be inferred from the statement (Am. Journ. Conchology, 1866, II, p. 90), that *Naticina obliqua* and *Turritella Uvasana*, species claimed to be eocene by Conrad, were "found by Mr. Rémond and myself in strata containing *Ammonites* and *Baculites*, and abounding in other cretaceous forms." A reference to the descriptions of these two species, as well as to the various tables of distribution published (before and after the making of the statement) by Gabb, clearly shows that the forms in question were *not* known to that paleontologist to pass beyond the limits of Division B. How then could they be associated with the *Baculites*, when the only Californian species of that genus, *B. Chicoensis*, is distinctly stated (I, p. 81) to be "only found in Div. A"? So likewise from the statement (Am. Journ. Conchology, II, p. 89), that *? Ammonites Cooperii*," one of the *Ammonitidæ*, whether an *Ammonite* or not, is from the presumed eocene of Mr. Conrad, from San Diego, and the family is sufficient to establish the age of that deposit, had we no other proof." But singularly enough, in the description of this ammonitic fragment (I, p. 70), the specimen is said to be "of particular interest from the fact that it is *one of the oldest* fossils found in the southern part of the State, being *considerably below* the newer cretaceous fossils of San Diego!" (The italics belong to the writer of this article). And in vol. II (p. 212) the species is doubtfully referred to the Chico group!

(cretaceous) deposits, and a few undoubted representatives of the *Ammonitidæ*, are of tertiary (eocene) age, and for the following reasons:

I. The large percentage (about 80, or possibly considerable more) of specific forms that are peculiar to the group, or, at least are not found in the older deposits;

II. The large proportion of generic forms (33 out of 77) that are not represented in the underlying or older strata;

III. The presence of 22 more or less distinctively tertiary genera: *Ancillaria*, *Bulla*, *Bullæa* (*Megistostoma*), *Bullia* (s. g. *Molopophorus*) *Conus*, *Crepidula*, *Cassidaria*, *Cancellaria*, *Cypræa*, *Ficus* (*Ficopsis*), *Gadus*, *Mitra*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Pseudoliva*, *Rimella*, *Sigaretus* (or *Naticina*), *Terebra*, *Triton*, *Trochita*, and *Typhis*;

IV. The marked absence (with the exception of about a half-a-dozen fragments or specimens of *Ammonitidæ*) of distinctively cretaceous organic types;

V. The identity, or very close analogy existing between several of the specific forms and their representatives from other well determined tertiary (eocene) deposits.[1]

[1] The eocene age of the Tejon rocks is maintained by Prof. Jules Marcou (Report of the Chief of Engineers, Washington, 1876, p. 387), who made a personal examination of the region. "I was not able to find a single cretaceous fossil, nor even any true cretaceous generic forms, in the entire

JULY 11, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Thirteen persons present.

A paper was received for publication, through the Botanical Section of the Academy, entitled "On Rhus cotinoides," by Dr. Chas. Mohr.

JULY 18, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Nine persons present.

Nest of Chætura pelasgia.—Mr. THOMAS MEEHAN exhibited a nest of the chimney-swallow, or swift, from a chimney in Germantown. It was made of small twigs of the cherry-tree, and fastened together, and to the wall of the chimney by vegetable gum of some kind, indeed, pure gum, undistinguishable in taste and general appearance from the kind which exudes from cherry-trees. He referred to the statement of Audubon, and which has apparently been copied without further question by subsequent authors, that the gum used by the bird in the building of its nest is a salivaceous secretion of its own, and that there are within the mouth of the bird, special organs provided for this secretion. Only for this positive statement of Audubon there would be no question, he thought, that this was cherry-gum, obtained at the same time and place from where the twigs were obtained, namely, the cherry-tree. It was not easy to tell one kind of gum from another in the absence of chemical analysis, but he believed there was no difficulty in distinguishing animal gum from the gum yielded by vegetables. It was inconceivable that an animal should secrete vegetable gum. Still, in view of Audubon's statement, the question was one for anatomists to settle.

It was, he said, worthy of remark that other species of swallow used vegetable gum for nest making. A cave-swallow of Cochin China used a gelatinous seaweed, a species of *Gelidium* not far removed from *Chondrus crispus*, the well-known Irish moss, to make their nests. This formed the so-called edible nests of China. Lamaroux, as quoted by Dr. Peyre Porcher, in his "Medical Properties of Cryptogamous Plants," remarks that far inland the birds employed other material to build their nests, but secured some of the *Gelidium* which they employed to stick the materials together, and fasten the nest to its support. The collecting of vegetable gum for this purpose is expressly conceded in the case of this species.

[illegible] Mr. Meehan called attention to the fact that [illegible] the gum with which the twigs were coated, had evidently been [illegible] on the wall before the collection of the twigs; and as the twigs were pushed the gum was softened perhaps by [illegible] of water brought in the bird's bill, so that it [illegible] the twigs. This was evident by the lines of gummy threads which mostly started from the mass on the wall and [illegible] as they were drawn out, terminating in [illegible]. He called attention to the nest exhibited as being [illegible] but set regularly against the face of the wall. That this appeared to be intentional seemed evident from the fact that the [illegible] of the twigs all started from right to left and which after being fastened there by the gum, were bent around to the left, making a greater curve at the right, on account of the less resistance from the slender end of the twigs. This obliquity seemed a great advantage to the bird, as it provides for sitting nearly parallel with the wall. If the bird sat at right angles with the wall its long wings would be very much in the way of her work.

Miss Grace Anna Lewis remarked that she had once had an opportunity of seeing a chimney-bird at work repairing the nest upon which it was sitting. The bird adjusted a loose stick with ease, and then plastered it with its bill, using the latter in the manner of a trowel. It then waited quietly, apparently to give time for a further secretion, and worked and rested alternately, until the damage was repaired. All this was distinctly seen through a pipe hole opposite the nest of the bird.

Miss Lewis had seen many nests of the chimney-bird and did not think they were usually larger on one side than the other, but supposed that the specimen shown by Mr. Meehan, had been

RHUS COTINOIDES, NUTT.

BY CHARLES MOHR.

Since its discovery by Nuttall, in the year 1819, in Arkansas, and twenty-three years later by Prof. Buckley, in North Alabama, this tree has not been found by any other botanist, and our knowledge of it remained fragmentary and obscure.

After having been lost to the botanical world for fully forty years, its re-discovery and observation in the various stages of its growth was deemed of sufficient interest to be made a special object in my investigation of the forest growth of the Gulf region for the Tenth Census. To this end, several trips were made to the southern declivity of the Cumberland Mountains as they descend upon the valley of the Tennessee River in Madison County, Ala. On the 21st of September, a successful search for the Baily farm was made, where, in the mountains near by, Prof. Buckley found the tree in the beginning of April, 1841.[1] This place is situated near the base of a bold mountain range rising to a height of 900–1000 feet above the Tennessee River.

The sight of my botanizing capsule dimly recalled to the present owner, the Professor's visit at his father's, but he had no conception of its object. He informed me that there is a small tree found in abundance in the low foothills skirting the valley, yielding a yellow wood used for dyeing, which he considered to be the tree I was in search of; and as fine specimens could be obtained nearer by, the trouble of hauling them down the mountain could be avoided.

Great was my disappointment when the *Rhamnus Carolinianus* was pointed out to me as the yellow wood. I felt quite relieved by the forthcoming statement that there was another kind of the yellow wood found on the rocky benches near the summit of the mountain, of which his father brought down a stick over 30 years ago, to serve, on account of its strength and durability, as a cross-piece to the rack used in his slaughter-pen. On a closer examination it was found to be a kind of timber I had never seen before, and after an exposure for such a length of time was perfectly solid, sound, and to all appearances as durable as ever. No time was

[1] Proceed. Acad. Nat. Science of Phila., June, 1881.

lost now in looking for its source on the mountain. The lower flanks of the range, less steeply inclined, with a rich, deep soil, are almost entirely under cultivation; the steep incline above the clearings, with its rock-covered ground, supports a fine forest of Mountain Oaks (*Quercus Prinus*), Chestnuts, Black Ash (*Fraxinus quadrangulata*), Elm (*Ulmus Americana*), Maples (*Acer saccharinum* var. *nigrum*), Mocker-nuts (*Carya tomentosa*), interspered with copses of Red Cedar (*Juniperus Virginiana*), with a dense undergrowth of trees of smaller size; Plums (*Prunus Americana*), Black Haws (*Viburnum prunifolium*), Hornbeam (*Carpinus Americana*), and various shrubs, *Rhus aromatica*, *Forestiera ligustrina*, etc. The heavy outcrops of this mountain limestone form on the steep declivity extensive le[illegible]race-like shelves traversed by shallow ravines—thei[illegible]hich cover the ground, making the access to these woods q[illegible]icult. It was upon this rocky soil, amongst its varied fore[illegible]tation, that the coveted object of my search was found gro[illegible] Not more than half a dozen trees of the same kind were fo[illegible]n this locality, scattered along one of the rocky ravines, mea[illegible]ng from 25–35 feet in height. The largest one felled measu[illegible]5 feet in length and 12 inches in diameter one foot above th[illegible]und.

Arrived at such dimension[illegible] tree has evidently long passed the best period of its life, j[illegible]rom the decay by which, more or less, the trunk was found affected. No sign of a decline, however, could be observed in the vigor of its vegetation.

The trunk divides at a height from 12 to 14 feet above its base; the primary limbs are erect, the secondary branches widely spreading, often slightly reclining, smooth and divide into numerous divaricate reddish branchlets rugose from the base of the leaf-stalks of the previous season. The bark is rough, covered with a whitish gray epidermis of a deep chestnut-brown underneath, and exfoliating in oblong square scales of uniform size. The inner bark is white, exposed to the air turning rapidly to a deep yellow color, and exudes, when bruised, a resinous sap of a heavy, disagreeable terebinthinous odor. The wood is heavy, very compact, of a fine grain; the white sap wood of small proportion surrounds, as a narrow ring, the deep yellow hard wood, variegated by zones of different shades of brown, imparting to it a beautiful appearance when polished.

The leaves are from $2\frac{1}{2}$ to 6 inches long, from $1\frac{1}{2}$ to 3 inches

wide, broadly ovate, obtuse, slightly emarginate, and attenuate at the base, with a strong mid-rib prominent; primary veins of a purplish color, sparsely pubescent while young; perfectly smooth later in the season; of a bright green, with a soft, glaucous hue. The panicle is open, 8 to 12 inches long, and almost as wide, with horizontally-spreading branches, which, like the common peduncle, are smooth, subtended like its crowded, numerous ultimate divisions by marcescent, finally deciduous lanceolate bracts. The flower-bearing pedicels are erect, one inch or over in length, and sparsely hirsute. The shorter, almost capillary abortive divisions, are gracefully received and bent, densely plumose by long spreading jointed hairs of a purplish tint.

Flowers perfect, minute; calyx deeply five-parted, the lanceolate lobes veined and with a mid-rib little over one-half the length of the persistent, greenish white ligulate petals, which are inserted between the sepals and the thin, broad purplish disk. Stamens short. Ovary with 3 short lateral styles. Drupe hard, oblique, semi-obcordate, $\frac{1}{8}$ inch by its largest diameter; the coriaceous brownish epicarp prominently veined and reticulated, investing closely the tough testa. Cotyledons accumbent.

The inner bark and wood are used for dyeing yellow, and it is said, also, for the production of purple tints. On this point, however, no definite information could be obtained.

Large numbers of trees were cut down during the war to procure a dyestuff much valued at the time, and full-grown ones are now quite scarce near the settlements. On account of the beauty of its wood, the tree is called Shittim-wood by the negroes, they believing it to be same which was used in the construction of the tabernacle in Solomon's Temple. The wood permits of the finest finish; the fineness of its grain, beauty of color and its hardness fit it well for inlaid work, veneering, and the manufacture of smaller articles of all kinds of fancy woodwork.

As an ornamental tree it far surpasses the European species, and will be found quite as hardy.

On the 3d of May it was found almost past blooming, a few belated flowers allowed the examination of its floral organs. On the 29th, it had fully ripened its fruit, the panicle had begun to dry up, and its pedicels were already a prey to wind and weather. In searching for the flowering tree, extensive coppices were found on the southern slope of Mount Sano, east of Huntsville, the second

growth from numerous stumps of full-grown trees cut down during the last half century, to serve as kindling-wood. Its resinous wood burning easily with a bright flame, this rare and interesting tree is constantly sacrificed to such low purposes wherever found easy of access. Within the narrow limits to which it is confined, it would be doomed to rapid extinction if it were not for the production of numerous rapidly-growing sprouts, giving rise to a copious second growth. It produces seeds but sparingly, all efforts to produce seedlings or young trees for transplanting failed. It seems to be easily propagated by layers, judging from some accidentally prostrated limbs, which, where in contact with the ground, were found rooting.

As observed in this state, this tree appears principally confined to the southern declivities of the mountains, from the northern border of the valley of the Tennessee, and *strictly* to the habitat described. It was never found on the sandstone cliffs which but a short distance higher up overlay the limestone strata, nor lower down the mountain sides, where the soil is deep and rich. According to Prof. Buckley, stunted specimens were first seen by him near Ditto's Landing, on the southern bank of the stream. The writer failed to meet it in his travels through the mountain region bordering south upon the basin of the Tennessee River. It is said to extend northward into the State of Tennessee, following the flanks of the Cumberland Mountains in their northeastern [redacted]

AUGUST 1, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Summer Migration of the Robin.—Mr. THOS. MEEHAN remarked that Audubon, Nuttall, Wilson, and other eminent ornithologists, had suggested that the seasons had evidently not so much to do with the migration of birds, as the question of food, though most authors connected this question of food with the autumn or winter season. He said he had recently observed the migration of the robin (*Turdus migratorius*) in great numbers during the ten days prior to August 1, or on the evenings of those days, for the flight was from about sundown to dark. They came from the northwest, and were flying southeast. Some were but a few hundred feet, but others were so high as to be scarcely visible, which would indicate a long journey. Robins had abounded on his property in Germantown during the past spring and early summer. He might say, without exaggeration, there were many hundreds of them. On the day of this communication, August 1, it was rare to meet with one. He considered the question of disappearance wholly one of food. On his grounds there had been no rain of any consequence for two months. For two weeks past numerous trees and plants had to be kept alive by artificial watering. Examining the dry earth after the harrow, he found few signs of insect life. The cherry crop had been nearly a failure. The usual berried plants, such as dog-wood, on which they generally fed, were not ripe. There was really little for them to eat, and he had reason to believe that the same conditions prevailed all over northern Pennsylvania. In New Jersey, plants with berries were ripening, as they were also further south, and he concluded this search for food was in this instance the cause of the early migration.

Night-closing in the Leaves of Purslane.—Mr. MEEHAN noted that in the list of plants having diurnal or nocturnal motion, *Portulaca oleracea* did not appear. At sundown the leaves, at other times at right-angles with the stem, rose and pressed their upper surfaces against it. The morning expansion began with dawn, and soon after sunrise the leaves were fully expanded. Mr. Isaac Burk had also observed it, as also in an allied plant of the West Indies, *Talinum patens.*

AUGUST 8, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Colored Flowers in the Carrot.—Mr. THOS. MEEHAN remarked

that the umbellet of colored flowers in the centre of the umbel of the carrot, was represented as usually fertile in Europe and sterile in the United States. He had always found them sterile in the United States until this season, when he discovered that those in the centre of the first umbel of the season were fertile. Those in the umbels from lateral shoots were sterile. This had, no doubt, always been the case—the laterals probably being the only ones examined in former investigations.

AUGUST 15, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Heliotropism in Sunflowers.—Mr. THOS. MEEHAN exhibited flowers of *Helianthus mollis*, and remarked on the popular fallacy regarding sunflowers turning with the sun. The original "sunflower," connected with the Ovidian stories of Clytie and Phœbus, was the European heliotrope, and even that did not turn with the sun in the modern popular sense. It simply grew where the sun loved to shine, and the plant did not flower till the sun had reached its summer solstice. The tragical part of the mythological story is founded on the fact that the plant continued to open its flowers as the sun declined, or, as Ovid might say, its affection for its beloved was in proportion as the lover fled from her to his winter quarters. The *Helianthus* was named sunflower, simply because the flowers resembled the sun, and there is no relation between it and the sunflower of mythology. Yet there are peculiarities

[redacted]

August, by the 11th there were sixty-eight flowers expanded, all facing exactly southeast on opening; but on the evening of this day, three were found which had changed around to northeast, with a slight tendency up from the horizon. On the 14th, there were seventy-three flowers open, twenty-one of which faced northeast. On examining the matter carefully, the inclination to the north was found to be due to a slight spiral or uncoiling growth during the advance from the horizontal rest to the erect position. All do not do this, but uncurve rather than uncoil. While this accounted for the northward advance, often as much as ninety degrees in a number of flowers, it still left the reason for the original facing of the flower to the southeast, among the many problems of plant-life yet to be solved. He referred to the several reasons offered in explanation of polarity in the leaves of the compass-plant, pointing out the unsatisfactory character of all of them.

AUGUST 22, 1882.

The President, DR. LEIDY, in the chair.

Ten persons present.

AUGUST 29, 1882.

The President, DR. LEIDY, in the chair.

Twenty-three persons present.

SEPTEMBER 5, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

A paper entitled "Conchologia Hongkongensis," by T. W. Eastlake, was presented for publication.

Vitality of Fresh-water Polyps.—Dr. H. ALLEN called attention to tenacity of life as exhibited in a fresh-water polyzoon (*Plumatella vesicularia*, Leidy). The leaf of the lily on which the colony had fixed itself, had been, by accident, removed from the water of the aquarium, and had been exposed for sixteen hours to the air. The animals had apparently become dry, and the colony itself barely visible to the unaided eye. Upon being again immersed (in water that chanced to be impregnated with iron-rust), the animals revived and flourished for two weeks, at the end of which time they perished from the effects of the decay of the leaf on

which they were growing. The following facts were thought to be of interest in this connection. First, that in these animals, relatively high in organization, aeration may go on for a number of hours by means of the retracted tentacles in the small amount of water contained within the cells. Second, that the presence of oxide of iron in the water does not interfere with the growth of the animals. And third, that the genus *Plumatella* may be found to resemble other mollusk-like creatures not only in their plan of organization, but in their habits of sustaining life for long periods after removal of the animals from water. The last-named fact may possibly enter into questions of geographical distribution of this and allied forms.

On Bàlanus, etc., at Bass Rocks, Mass.—Prof. LEIDY remarked that the Barnacle, *Balanus balanoides*, of which he presented a series of specimens from Bass Rocks, Gloucester Co., Mass., is found everywhere in the greatest profusion covering the rocks, between tides, on our eastern coast. It is also common on many other more or less fixed objects, such as shells of dead or living mollusks, lobsters and crabs, old wrecks of vessels, etc. The specimens presented are interesting from their exhibiting a remarkable variation in form, mainly due to the difference in the extent of room in which they grow. In general when isolated or with ample space, the shells are comparatively broad and low, and narrowed from their base of attachment to the aperture; or they are in the shape of short truncated cones, with the breadth as great or greater than the length. When crowded more or less close together, they assume a longer, narrower, cylindrical form, expanding towards the mouth; and thus they may become three [redacted]

Height.	Breadth at base —	and then contracting to the mouth.
12 mm.	12	10
11	10	8
10	13	10
8	15	8

The specimens of *Littorina litorea* and of *Purpura lapillus* presented were also collected at Bass Rocks where they occurred in great abundance, and appeared to be the commonest gasteropods of the locality. The former is described in the report on the Invertebrata of Massachusetts, of Gould and Binney, but the only locality given for it is Halifax, while it is not noticed as occurring at Vineyard Sound in the report of the U. S. Commission of Fish, Pt. i, 1873.

SEPTEMBER 12, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-seven persons present.

The death of Wm. H. Allen, a member, August 29, 1882, was announced.

The following were ordered to be published:—

NOTICE OF DR. ROBERT BRIDGES.

BY W. S. W. RUSCHENBERGER, M. D.

Amidst the great population of the city, the Academy is comparatively a very small body; in fact, a mere company addicted to studies in which our fellow-citizens generally take not much interest; so little, indeed, that they hardly care to understand the nature of the work done in the institution, or to appreciate its value to the community.

General literature, the drama, music, the fine arts, attract and divert the people so satisfactorily that belles-lettres writers, poets, painters and sculptors who are skilful, are almost universally admired, and become celebrated widely and attain a higher position in public estimation than unobtrusive votaries of science, whose real worth is rightly appreciated solely by the few. Only pre-eminently great scientists and naturalists acquire position among the hosts of men distinguished because they have aided in some way the progress of civilization. The merits of individuals of the rank and file, whose labors contribute largely to the success and fame of the leaders, are too frequently overlooked.

The Natural Sciences occupy a boundless field. Its cultivation is endless, and, when a society undertakes it, requires laborers of almost every variety of qualification and degree of intelligence. Properly mounting, labeling, classifying specimens in the museum, and cataloguing and arranging books in the library for ready reference may be done by persons not qualified to recognize or describe new species; yet this comparatively inferior kind of work is of much value in facilitating the labors of those engaged in other parts of the field. The discovery and definition of new genera and species, though of very great importance, are not the sole objects of the society's pursuit. Successful generalization demands a different kind of intelligence and more extensive acquirements than special description of forms.

A good name properly earned by an individual in any department of our little community is in itself a contribution to the fair reputation of the Academy; and this is worth consideration, because the good name of the institution carries with it an influence which is important to its progress and prosperity. A good

name, therefore, is among the valuables of the corporation, to be transmitted to future members, as a common inheritance. One who contributes towards the advancement of science, either directly or indirectly; who leaves the Academy in better condition because he has passed part of his life in it, is surely worthy of remembrance. Whenever one dies who has attained distinction within our little world, through his services to the common cause, a suitable record of his worth should be made, that his successors may know to whom they are indebted and be reasonably grateful. There have been and there are now members, who, on account of their contributions towards the advancement of science and the progress of the society, are entitled to more than ordinary respect—men whose conduct is worthy of admiration and imitation, at least by all those who have like scientific tastes and tendencies.

The records of the society show that among these Dr. Robert Bridges held a prominent place. A sketch of his career in the Academy only is offered here.

He was born in Philadelphia, March 5, 1806, and died in this city, February 20, 1882, at the age of very nearly seventy-six years.

Dr. Robert Bridges was elected a member of the Academy of Natural Sciences of Philadelphia, January, 1835.

His first work was an *Index of the Genera in the Herbarium*, prepared by him and Dr. Paul B. Goddard, which he presented to the Academy, August, 1835.

He was elected Librarian, June 28, 1836, and served till May 28, 1839—two years and eleven months—when he resigned. He assisted in preparing and printing the first catalogue of the library. The Academy presented its thanks to him for "the able and efficient discharge of the duties of librarian."

In the course of the years 1839-40, he served as Recording Secretary *pro tempore*, during five months.

He was elected Corresponding Secretary, May, 1840, and served till December, 1841, one year and seven months.

He was a Vice-President from September, 1850—succeeding Dr. R. Eglesfield Griffith, who died June 26—till December, 1864, fourteen years and three months, when he was chosen President. He declined re-election, December, 1865.

He was an Auditor six years, from December, 1843, till December, 1849.

He was a member of the *Publication Committee* from December, 1837, till December, 1838; and again from December, 1849, till December, 1872, when he declined re-election, having served twenty-three years. He was chairman of the committee from December, 1865, till December, 1872.

He was a member of the *Library Committee* twenty-nine years, from December, 1842, till December, 1871, and chairman of it from December, 1846, till December, 1853.

He was a member of the *Committee on Proceedings* seven years, from January, 1862, till January, 1869; and of the *Finance Committee* five years, from December, 1869, till December, 1874.

He was elected a member of the *Botanical Committee*, January, 1836, was chairman of it from December, 1846, and served till December, 1857, twenty-one years, when he declined re-election. For his official services the Academy voted him its thanks, December 28, 1841. On the 23d of May, 1843, he presented a *New Index of the Herbarium*, and one of *Menke's Herbarium*, from the Committee, a work which was long the main guide to the botanical collections.

He was elected a member of the *Committee on Entomology and Crustaca*, January, 1849, became chairman of it January, 1858, and served till December, 1865, seventeen years. He labeled, catalogued and arranged anew the collection of Crustaca according to the nomenclature and classification accepted at that time as the best.

He was nine years a member of the *Committee on Herpetology and Ichthyology*, from January, 1857, till January, 1866, and was chairman of it from January, 1860.

He was elected, January, 1866, a member of the *Committee on Physics;* became chairman of it, January, 1868, and served till May, 1876, ten years and four months.

He was a member of the *Committee on Chemistry* five years and four months, from December, 1870, till May, 1876, when all the standing committees were abolished.

Under the By-Laws adopted May 25, 1869, a Council was created. Dr. Bridges was elected a Councillor, December 28, 1869, and served till May, 1876, six years and four months.

A committee was raised, June 30, 1846, to devise means of accommodating the Duc de Rivoli's collection of birds, which had been just purchased by Dr. Thomas B. Wilson. Dr. Bridges was

appointed a member of the committee, which reported, August 18th, a plan for extending the building thirty feet westward. The report was adopted, and the committee, then made the Building Committee, was instructed to execute the plan.

Again, December 30, 1851, Dr. Bridges was appointed a member of a committee to solicit subscriptions to enlarge and improve the hall. The committee reported, January 25, 1853, that the estimated sum required had been subscribed. Dr. Thomas B. Wilson, Dr. Robert Bridges and Mr. Wm. S. Vaux were appointed a Building Committee to execute the plans of improvement. In behalf of the committee, Mr. Vaux reported, December, 1855, that the work of raising the previously enlarged building twenty-four feet had been completed at a cost of $12,263, which had been paid.

Dr. Bridges was appointed, December 26, 1865, one of a Committee of forty members to solicit subscriptions to erect a fire-proof building for the use of the Academy, and he was elected, January 8, 1867, a member of the Board of Trustees of the Building Fund, and by it, January 11, 1867, a member of the Building Committee, in which he was active till the society was established in its new hall, January, 1876.

Besides serving the society as Librarian, Recording Secretary, Corresponding Secretary, Auditor, Vice-President and President, member of numerous Standing Committees, as well as of very many Special Committees, he contributed to its funds, to its library and to its museum. In all the many years of his activity he was rarely absent from the meetings of the Academy, and discharged all duties imposed upon him promptly and efficiently.

His numerous official services, presented here in summary, imply that he had the kindly respect and confidence of his fellow-members; and it may be said that the record of his labors expresses all the eulogium required. Almost all his time not occupied by his professional avocations was employed, during more than forty years, in working faithfully, disinterestedly, to promote the acquirement and diffusion of knowledge of natural history which are the chief purposes of the society. He was remarkably courteous to students, and always seemed pleased to assist them in their inquiries and pursuits. His learning was varied and extensive and minutely accurate, but he was so modest, unassuming, that it was necessary to apply to him for information to perceive the

wealth of knowledge at his command. He was an expert chemist, a good botanist, and well versed in almost all the natural sciences; yet he published little, and seldom engaged in debate. But his good sense and independent judgment, his rigid probity and loyalty to truth in every aspect, his punctual faithfulness to all obligations, his cheerful and benevolent disposition and tranquil deportment at all times, combined to render his presence in the society a beneficial influence on its progress, an influence which cannot be made manifest by instances or definitely measured.

His interest in the Academy was unremitting till the close of his life. After impaired health prevented him from being active in its affairs and from being present at the meetings, he often found recreation during the day in passing hours reading in the library.

The Academy has had among its members many distinguished, and some wealthy and beneficent friends, but none more constant, none who has worked more industriously and efficiently for its advancement than Dr. Robert Bridges. His givings to it were as generous as his comparatively narrow circumstances justly allowed. No striking invention, no discovery in science is ascribed to him, but laboriousness, sincerity of purpose and faithfulness were so manifest in all his ways that he had the confidence of all. He earned for himself a good name in the society, and is entitled to be long remembered among us, kindly and respectfully.

[redacted]

CONCHOLOGIA HONGKONGENSIS.

BY T. W. EASTLAKE.

The recent publications of Dr. O. F. von Möllendorff and Père Heude, S. J., have thrown a new light on the conchology of the Yangtze-kiang River, and some of the provinces of Southern China, in a very welcome manner. The land, whose conchology found its pioneers in Swinhoe and Fortune, is becoming daily better known to the scientists of Europe. Indomitable energy and steady perseverance on the one hand, together with the keen eye of the scientific traveler on the other, are establishing the zoology of China—immense as is that country—on a firm scientific basis. Still there is a wide field for investigation. The transition stages of the zoology of Central Asia into that of Western China, have yet to be carefully examined. Again, some branches have been almost totally neglected. The entomology of China is only known through the medium of Donovan's "Insects of China," a work which, at present, has but little more scientific value than that of a child's picture-book. Until recently, conchology was still worse represented. A few remarks in the itineraries of passing scientists, a chapter or two in the chronicles of occasional expeditions, a short paper in the transactions of zoological societies—these were the only sources from which any knowledge of the conchology of China could be gleaned.

Under these circumstances, the publication of the "Mémoires concernant l'Histoire Naturelle de l'Empire Chinois," is heartily welcome, and great credit is due to Père Heude for his "Notes sur les Molluscs de la Vallée du Fleuve Bleu." Still one cannot refrain from regretting that the Rev. Father has undertaken such a work without a thorough knowledge of conchology itself—a neglect which is strongly apparent in the occasional confusion of similar genera, and the application of new names to old and well-known species. In this manner, no less than seven of Père Heude's *Clausiliæ* resolve themselves into varieties of *Clausilia aculus*, Benson, originally found in the Chusan Islands by Swinhoe, and later at Kiu-kiang by von Möllendorff. Père Heude's work adds over one hundred new species to the land shells of the Yangtze-kiang.

Of far greater scientific value are Dr. von Möllendorff's papers, which have appeared in the publications of the "Malakozoologische Gesellschaft," of Germany, and in the Transactions of the Bengal Branch of the Royal Asiatic Society. Von Möllendorff is a thorough scientist, and his new work on the "Conchology of Southern China" (shortly to appear) promises to be indispensable as a text-book.

It is remarkable that the Island of Hongkong should have produced so many indigenous species. A British possession for more than thirty years, hardly one scientific expedition has touched the shores of this "barren rock in the ocean," without discovering a new species. Of late years, Drs. von Möllendorff, Hungerford, and the writer, have carefully gone over the greater part of the island, not only discovering new species, but rediscovering others which had disappeared since Stimpson's visit to Hongkong—nearly thirty years ago.

There are only a very few places where shells are to be found, as the larger part of the island consists of naked rocks, or is sparsely covered by *Gleichenia dichotoma*—a fern which is a sure indication of the absence of terrestrial mollusca. In the valleys, however, vegetation is luxuriant, and it is in these places that most of the shells are to be found. The dense woods of Little Hongkong (a Chinese village about 6 miles from the colony), and the little valley near Sheko (10 miles from the colony), are favorite [redacted]

Cyclophorus exaltatus, Pfeiffer. Little Hongkong.

This is the commonest species of the Cyclostomidæ, and is not confined to the island, having been found by the writer some distance in the interior of the Kwang-tung province. Found in Hongkong by Fortune; later by E. von Martens. Reeve, in his Conchologia Iconica confounds *C. exaltatus* with *C. volvulus* (*lituus*) from Siam. That they resemble each other is true, but *C. exaltatus* is always smaller, the shell is thinner and without a ridge about the umbilicus. Closely related to this species is *C. Martensianus*, v. Mlldff., found at Kiu-kiang by von Möllendorff and Père Heude; by the writer at the Yung-fu monastery, Fukien province. Cf. Jahrb. I, 1874, p. 78; II, 1875, p. 120. E. von Martens, ibid., p. 127.

Cyclophorus pellicosta, von Möllendorff. High West.

Originally described from the Lo-foo-shan, a range of mountains near Canton City. Rare.

Cyclophorus trichophorus (Craspedotropis), v. Mlldff. Little Hongkong

Described originally from the Lo-foo-shan, near the monastery of Washau. Since found by Dr. von Möllendorff at Ding-hu-shan (Kwang-tung province), and at Little Hongkong by the writer.

Cyclophorus (Leptopomoides) cuticosta von Mlldff.

Found first in Hongkong by Drs. von Möllendorff and Hungerford, again at Tong-chow, not far from Macao, by Dr. Hungerford and the writer; finally, near the monastery of Yung-fu, in the Fukien province, by the writer.

Cyclotus Chinensis, Pfeiffer. High West.

Had disappeared since 1850; rediscovered by Dr. von Möllendorff.

Alycaeus pilula, Gould.

For many years this shell was supposed to have disappeared from Hongkong, but it was the writer's good fortune to find a solitary specimen on High West (July 16, 1882), a description of which will shortly be published by Dr. von Möllendorff. E. von Martens (Jahr. II, 1875, p. 127), writes that the species is not known to him either through an engraving or any specimen. It is closely allied to *Alycaeus Kobeltianus*, found by von Möllendorff at Kin-kiang.

Paxillus tantillus, Gould.

This species has never been found since Stimpson's visit to the island. It may, however, exist in the woods near Little Hongkong.

Helicina Hungerfordiana, von Mlldff.

Found at High West (Hongkong) by Dr. Hungerford, Dr. von Möllendorff, and the writer; at Tung-chow (near Macao) by Dr. Hungerford and self.

Helicarion imperator, Gould. Sheko and Little Hongkong.

In 1875 only five specimens were known in Europe. Confined to Hongkong.

Helix similaris, Ferussac. Common.

H. similaris, Fer. Prod., 1821; **H. Hongkongensis**, Desh.; **H. obscura**, Desh.

There are evidently two varieties of this shell in Hongkong. The larger approaches somewhat *H. ravida*, Benson. Deshayes' description of *H. Hongkongensis* proves that he was unacquainted with the latter variety.

Helix Gerlachi, von Mlldff. High West.

Originally described from the Lo-foo-shan.

Helix xanthoderma, von Mlldff. Sheko.

One of the rarest and largest shells of the island. Indigenous to Hongkong.

Helix (Corilla) pulvinaris, Gould. High West.

[redacted]

Helix, nova species, undescribed. High West.

Helix (ruficrissa, von Mlldff.), nova species, undescribed. Little Hongkong.

Microcystis Schmackeriana, von Mlldff.

Found in Hongkong (near Aberdeen), by Herr Schmacker; in the Lo-foo-shan Mountains by Dr. von Möllendorff; at Low-da on the Yung-fu River, province of Fukien, by the writer.

Helix (an Cochlostyla ?) xanthoderma, von Mlldff.

A. typus? Diam. maj. 50, min. 43, alt. 45 mm.

Habitat ad Montem Ma-on-shan, provinciæ sinensis Kuang-tung.

B. forma minor. Diam. maj. 44, min. 37, alt. 40 mm.

Habitat in insula Hongkong (Sheko).

Stenogyra (Opeas) Fortunei, Pfeiffer. Common.

Fortune found this shell near Shanghai, and Canton, according to Reeve, in Macao (I have not found it there). There is considerable doubt whether the Hongkong *Stenogyra* is in reality *Fortunei*; that it closely approximates the typical shell is beyond question.

Stenogyra (Opeas) chinensis, Pfeiffer. Common.

Clausilia lorraini, Mencke. Sheko.

Tolerably abundant; confined to the Sheko Valley.

Streptaxis sinensis, Gould. High West and Little H.

Tolerably rare. Best specimens from Little Hongkong. Found also at the Lo-foo-shan and elsewhere in the province of Kwangtung.

Ennea bicolor, Hutton.

This shell is one of the widest-spread of the Gonospiræ, having been found in Burmah (Gould), Cochinchina (Michau), Mauritius (Benson), St. Thomas (Bland), and according to Benson, in Ceylon. Hutton first described it from Mirzapoor. In Hongkong this beautiful *Ennea* is quite rare, and has been found in Sheko by Dr. von Möllendorff.

Succinea chinensis, Pfeiffer. Botanical Gardens.

This *Succinia* seems never to attain any large size in Hongkong. Specimens from Amoy and Swatow in the writer's collection are much better developed, and more characteristic of the species.

Macrochlamys superlita, Morelet. Sheko.

Perfect specimens very rare, as the shell is extremely fragile.

Besides the list given above there are two Microcystis, as yet unnamed. One *Microcystis* (*Eastlakeana*, v. Mlldff.), found by the writer near Little Hongkong; the other tolerably common on old walls and trees throughout the N. E. portion of the island. Also one *Conulus*, frem High West, undescribed.

Fresh-Water Snails.

Limnæa ollula, Benson.	Streams near L. Hongkong.
Limnæa plicatula, Benson.	Streams near L. Hongkong.

This latter species is by far the rarer of the two. A variety of *L. plicatula* has been found by Dr. v. Möllendorff and the writer on the mainland, some twenty miles from Hongkong.

Planorbis compressus, Benson.	Streams near Aberdeen.
Planorbis Cantori, Benson.	Victoria Peak.
Corticula lutea, Morelet.	Near Sheko.

Of slugs there are only two species found on the island.

Philomicus bilineatus, Benson.
Vaginulus chinensis, v. Mlldff., nova species.

Pallium supra confertim minute granulatum, obscure cinereo-fuscum, maculis pallide fusco-flavidis ad margines crebrioribus sparsum, medio striga flavida parum distincta notatum, infra pallide flavogriseum, unicolor, pes flavidus. Tentacula superiora nigra, inferiora pallida.

Pallii long. 75, lat. 15; pedis lat. 5, tentac. sup. 6, inf. 3 mm. In hortis insulæ Hongkong.

[redacted]

SEPTEMBER 19, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-four persons present.

A paper entitled "Verification of the Habitat of Conrad's Mytilus bifurcatus," by R. E. C. Stearns, was presented for publication.

SEPTEMBER 26, 1882.

The President, Dr. LEIDY, in the chair.

Twenty persons present.

A paper entitled "Rotifera without Rotary Organs," by Prof. Jos. Leidy, was presented for publication.

On the Tobacco-worm, etc.—Prof. LEIDY exhibited a collection of tobacco-worms, the larvæ of *Sphinx carolina*, which he had obtained two days ago from a tobacco-field, near Columbus, New Jersey, where they were very abundant, and had proved a great pest in the cultivation of tobacco. The worms collected presented a number of well-marked varieties, which were supposed to be all of the same species. The principal ones were indicated as follows:

1. Pea-green or yellowish green, more or less finely hairy, with lateral oblique white bands bordered above with black dots which extend to the dorsal median line; head bright pea-green, dorso-caudal spine red. This is the most common variety.

2. Pea-green, smooth, with lateral oblique white bands joined in front below by horizontal white bands so as to form a series of ⊳-like marks, the apex of each joining the lower limb of the one in advance; head green; dorso-caudal spine black.

3. Grass-green, smooth, with lateral white V-like marks as in No. 2; the oblique bands bordered above by blackish or brownish; upper part, especially in front, more or less dotted with white; head green, with a pair of black bands on each side; dorso-caudal spine black.

4. Yellowish green, annulated with narrow black lines; with lateral white V-like marks, the oblique bands bordered above with black; head bright pea-green; dorso-caudal spine red.

5. Dull green, with more or less brown dorsally and dotted with white, the dots more or less tuberculate, but otherwise smooth; with lateral white V-like marks, the oblique band bordered above with brown ascending to the dorsal median line; head green with a lateral pair of black bands; dorso-caudal spine black.

6. Chocolate-brown to nearly black, smooth, with white dots dorsally and anteriorly, with lateral white V-like marks; head shining black on each side; dorso-caudal spine shining black.

7. The same as No. 6, with lateral red V-like marks.

Among these more marked varieties others were noticed which were more or less of an intermediate character. The most common variety was that which was least distinguishable in color from the animal's location, the tobacco-leaf, so that it was especially favored in its preservation.

Prof. Leidy further remarked that the past season had appeared to be favorable to many of the Lepidoptera. Our shade-trees had been greatly ravaged by the *Orgyia;* many of the poplars had suffered from the *Clostera inclusa*, and he had observed an unusual quantity of the Ailanthus silk-worm, *Attacus cynthia*, upon the Ailanthus-trees. The latter was introduced here in 1861, by Dr. Thomas Stewardson.

Dr. Wm. M. Gray was elected a member.

OCTOBER 3, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-seven members present.

Apparent Bird Tracks by the Sea-shore.—Mr. THOMAS MEEHAN called attention to what appeared to be the track of a three-toed bird in the sand, near low-water mark, at Atlantic City. They were generally regarded by observers as bird tracks. While [redacted]

tion of the two hind-legs, made a tridentate obstruction to the sand brought down by the retreating wave, and the water passing around the points made the three toe-like grooves which resembled a bird's foot from one and a half to two inches long. The creatures in their scrambles for protection beneath the sand, managed to keep at fair distances from each other, and hence there was considerable regularity in the tracks as if they had really been produced by birds.

He added that he presented the observation as a mere trifle, but he could not help remarking that if by any means these trifid impressions should get filled with mud, and the deposit become solid rock, it would be very natural for observers, ignorant of their origin, to mistake marks like these for the tracks of birds.

Scent Organ of Papilio.—Mr. H. Skinner remarked that the larvæ of *Papilio turnus* and *P. troilus* when irritated, project from a slit in the prothoracic segment, an orange-colored bifid organ. The apparatus is a scent organ, and gives out a strong and disagreeable odor perceptible at some distance, and seems to be designed to defend the caterpillar from numerous enemies.

The anatomy of the organ seems to have escaped investigation, as most authors merely mention its existence, one describing it simply as fleshy. It has the appearance of being a solid organ, but it is in reality hollow throughout the entire extent, and of very thin texture, tapering gradually to a point. It is drawn in by invagination, and is protruded after the same method. If the larvæ be held so that the sunlight may pass through the extended organ, the process of intussusception may be distinctly seen.

Asymmetry of the Turbinated Bones.—Dr. Harrison Allen, in the course of remarks on the asymmetry of paired structures in mammals, invited the attention of the members to asymmetry in the inferior turbinated bones of the human subject. This asymmetry may exist independently of the deflection of the nasal septum, and may involve the entire length of the bones. The nasal chamber may also be asymmetrical, and even the choana of one side be much smaller than the space of the opposite side. It was thought that such asymmetry involving the pterygoid processes of the sphenoid bones, was due to early and probably pre-natal influences, as opposed to the asymmetry due to acquired deflection of the septum.

Some peculiarities of the floor of the nose which have not been described, were defined. Among these was mentioned the elevation of the premaxilla as it lies on the floor of the nose above the level of the horizontal plate of the superior maxilla. This elevation tended to conceal the inferior turbinated bone from inspection from the anterior nares. Some forms of obstruction to nasal respiration in man were thought by the speaker to be due to the conformation of the parts as described. A peculiar thickening of

the horizontal plates of the palatal bone, which was thought to be within the range of normal variation, was next mentioned.

The erectile character of the mucous membrane of the nasal chambers, while best developed upon the middle and turbinated bones, is also present about the organ of Jacobson. This phase of the erectile tissue, while rudimental in the human subject, is highly developed in the lower mammals, and is especially conspicuous in the domestic cat. Microscopical sections of the organs with their related erectile masses were exhibited, and attention invited to the probable use of the masses in guarding the anterior orifices of the nasal chambers. The erectile tissue may be said to open or close the orifices from within as the adductor and the abductor muscles of the wings of the nostrils may close or open them from without.

The following were ordered to be printed :—

VERIFICATION OF THE HABITAT OF CONRAD'S MYTILUS BIFURCATUS.

BY ROBERT E. C. STEARNS.

In the late Dr. Philip Carpenter's Report to the British Association (1856) on the Mollusca of the West Coast of North America, paragraph 39, occur these words:

"During the years 1834–5, Thomas Nuttall, Esq., for many years Professor of Natural History at Harvard University, Cambridge, U. S., visited the then almost unsearched shores of California, by a journey across the Rocky Mountains, under the escort of a trading company. Although his object was principally botanical, his love of natural science induced him to collect all the shells he could meet with; and with such good success, that many of his species have not to this day been again discovered. The peculiar interest attaching to his researches is, that he did not visit any part of the coast north of Oregon or south of San Diego. There is no danger, therefore, of any admixture with the shells of the Gulf district; and his collections may be regarded as the type of the Californian fauna strictly so-called. Leaving the American shores, Mr. Nuttall visited the Sandwich Islands, whence he only brought one species belonging to the American fauna, viz., *Hipponyx Grayanus*, on a *Pinna*.

"On his return to the United States, *via* Cape Horn, the description of the marine shells was undertaken by Mr. T. A. Conrad, and the land and fresh-water species by Mr. Lea. The latter gentleman communicated his paper to the American Philosophical Society, where it will be found in the 'Transactions,' vol. vi; Mr. Conrad read his paper before the Academy of Natural Sciences of Philadelphia, in January and February, 1837. It is published in the second part of the 'Journal' of the Society, vol. vii, pp. 227–268.

* * * * * * *

"The work bears the appearance of undue haste, * * * the localities cannot always be depended upon, * * * and the descriptions being in English would not have been entitled to claim precedence, were it not that they are accompanied by tolerably recognizable figures."[1]

[1] Jour. Ac. N. S., v. 7, Pl. 18, f. 14. Sp. 2184, Jay's Cat., p. 77, 4th ed., 1852.

On page 109 of the same (1856) report of Carpenter's, he gives *Mytilus bifurcatus*, Conr., Jay, 2184, "Sandwich Is."—"on rocks, bare at low water—Conr."; and adds: "No knowledge of the locality of this shell exists, except the statement of Conrad, which alone is not binding, and its appearance among the Mexican War shells, the collectors of which brought home nothing from the Sandwich Islands."

On page 563, in paragraph 62, of Carpenter's second report (1863), in commenting on the species and figures in Reeve's "Conch. .," he prints as follows: "41, *Mytilus bifurcatus*, Conr., J. A. N. S .b.: Co ssigns his Nuttallian species to California; but it is the co Sandwich Is. species, teste Pse. The Californian shell, w me sculpture, is a *Septifer*, and is the *S. bifurcatus* of s. |"

So far as regards the Sand Islands form, at this moment I am without specimens for arison, and am satisfied with Pease's identification as to resemblance. While Conrad was very often somewhat c in his work, in the case before us he was correct, and C 's criticism in this instance was not deserved, as *both Se* d *Mytilus*, that is to say both Reeve's and Conrad's species, found at San Diego, and an examination of numbers of specimens collected by different parties during the past ten years, shows that an examination of the *interior* of the valves is necessary in order to determine to which group specimens belong. I have been unable, after the most careful inspection, to find any external differences by which I could separate them.

The *Septifer* from the Gulf of California, in the Xantus collection No. 118 = 169 of the Mazatlan Catalogue, I am not familiar with, and would suggest its comparison with *S. bifurcatus*, but Carpenter's *Mytilus multiformis*, No. 117 of the Xantus list = 169 of the Mazatlan Catalogue, I should regard as the southern form of Conrad's *Mytilus bifurcatus*. Specimens of the two species are contained in my collection, in that of the Philadelphia Academy, and in the National Museum, Washington.

ROTIFERA WITHOUT ROTARY ORGANS.

BY PROF. JOSEPH LEIDY.

The Rotifera or Wheel-animalcules, form a small class, abundant in kind and found almost everywhere in association with Algæ, and with Infusorians to which they were formerly considered to belong. Later they have been recognized as not having the simple cell structure of the latter, and for a time were regarded as pertaining to the Crustacea. They are now commonly looked upon as belonging to the group of Worms, but their relative position cannot yet be considered as positively determined. They generally possess a chitinous integument with a more or less annulate disposition or tendency to articulate division; but they are destitute of limbs. Some are provided with a carapace and recall crustacean forms, but in other points they exhibit but little likeness to them. Their usually striking characteristic, the rotary disks, from which they are named, is not possessed by any well-marked Crustacean. Among the Rotifera, however, there appear to be some which do not possess the rotary organs, at least in the mature condition, and yet in all other respects the animals conform in structure with ordinary forms.

Dujardin (Infusoires, 1841, 653, Pl. 22, fig. 2) was the first to describe a Rotifer destitute of rotary organs, to which he gave the name of *Lindia torulosa*. It is a free, swimming, worm-like, telescopic form, common in the class.

Gosse (Annals and Mag. of Nat. Hist., 1851, viii, 199) described an allied form, without rotary organs, under the name of *Taphrocampa annulosa*.

Cohn (Zeits. f. wissens. Zoologie, 1858, 287, Taf. xiii, fig. 1, 2) described a Rotifer resembling *Lindia*, but possessing rotary organs. He supposes it to be the same; and suspects that in the animal observed by Dujardin, the rotary disks had been withdrawn, in a manner common to the class. He remarks that the existence of a Rotifer, without vibratile cilia, would be a rude abnormity in the class, the more so because the possession of cilia is the most important character which separates the Rotifers from the Crustaceans.

In a marginal note I find that some years ago, at Newport,

R. I., I observed a Rotifer apparently devoid of rotary organs, which I took to be the *Lindia* of Dujardin.

However, even previously to Cohn's communication (see these Proceedings, 1857, 204), I described an animal which I regarded as a Rotifer, without doubt entirely destitute of the characteristic rotary organs or any trace whatever of vibratile cilia. It was named *Dictyophora vorax;* and it is quite different in form from the preceding animals. It is spheroidal, inarticulate, without carapace, or jointed tail; and possesses a large protractile and retractile pouch or cup, as a substitute for the ordinary rotary disks. It is attached to fixed objects, and has been observed on several occasions adherent to stones and the glass of an aquarium. The description of the animal, unaccompanied by illustration, seems never to have attracted attention.

Some years subsequently, Meczinchow (Zeits. f. wis. Zoologie, 1866, 346, Taf. xix) described a similar Rotifer to mine, under the name of *Apsilus lentiformis.* It was found, at Giessen, attached to the leaves of *Nymphæa lutea.* It is larger than *Dictyophora*, and differs mainly in the possession of bristled tentacles (" Gefühlorgane ") and a ganglion to the pouch, neither of which were observed by me in *Dictyophora.*

The following year, Claparede (An. d. Sc. Nat., 1867, viii, 12, Pl. 4, figs. 3, 4) described another Rotifer, without the characteristic organs, under the name of *Balatro calvus.* It resembles the earlier described forms, and was observed to be parasitic on worms, in the River Seime, Canton of Geneva.

A short time since, Mr. S. A. Forbes (Am. Month. Micros. Jour., 1882, 102, 151), of Normal, Illinois, described a Rotifer, destitute of rotary disks, with the name of *Cupelopagus bucinedax.* It was found attached to the glass of an aquarium, and it appears to me to be so nearly like *Dictyophora vorax*, that I suspect it to be the same.

More recently, while examining some *Plumatella diffusa* from the Schuylkill River, below Fairmount dam, my attention was attracted to several groups of *Megalotrocha alba*, attached to the tubes of the former, and surrounding another animal of strange and novel character. This on examination proved to be another remarkable Rotifer, without rotary organs, and it is the interest which attaches to this discovery which has led to the present communication. As with many analagous things, I had not the

leisure to give it due study, and yet I felt that if I reserved it for future investigation, I might never meet with a more favorable opportunity for the purpose.

The new Rotifer I propose to name *Acyclus inquietus*, from its being destitute of wheels, or ciliated disks, and from its apparently restless habit. It is considerably larger than *Megalotrocha*, measures nearly a half line long, and can readily be distinguished, in groups of the latter, with the naked eye. It was observed in eight instances, in each, alone and always enclosed in a group of the *Megalotrocha*, above which, from its greater size, it towered like a giant in a crowd. In its constitution, for the most part it resembles *Megalotrocha*, and is attached in the same manner. In its movements it bends rather abruptly in different directions and curves downward so as to bring its prehensile mouth on a level with the currents produced by the rotary disks of the surrounding Megalotrochæ. Sometimes alone or in company with the latter, it suddenly contracts and then more slowly elongates and resumes its bending motions, scarcely for a moment appearing in an erect attitude. Occasionally it will even double on itself to such a degree that the extremities are approximated, or as the motion is commonly expressed, the head nearly touches the end of the tail or point of attachment. The movements of the creature recalled to me those of the avicularia of some of the marine Polyzoa, or of the pedicellaria of Echini.

At one time I had the opportunity of seeing an individual of *Plumatella* with outspread arms, and in its immediate vicinity a group of Megalotrochæ with open disks and an *Acyclus* in its midst, together with two worms of the genus *Dero*, with extended and expanded branchial tails, all acting together in concert, apparently perfectly regardless of the presence of one another—messmates partaking of the same repast.

Acyclus is translucent whitish with the thicker part of the body yellowish or brownish, due to the color of the capacious intestine shining through the integument. It was difficult to obtain a clear and accurate view of the exact mode of attachment and the internal structure of the animal, from its incessant motions, its becoming wrinkled in contraction, and from its being obscured by the surrounding bunch of Megalotrochæ. In the attempt to remove these, the *Acyclus* was detached and then would contract to such a degree, that nothing could be determined as to the arrangement

of its organs. Under the circumstances the accompanying figure 1, Plate II, of the animal, is to be regarded as only approximately correct. Most of the individuals seen were naked, like *Megalotrocha*, but had adherent a profusion of eggs. In two instances the animal was included in a copious colorless gelatinous sheath, as represented in the figure, but had also adherent a large bunch of eggs, in one of which bunches I counted upwards of fifty.

The head of *Acyclus* substitutes the rotary disk of the *Megalotrocha* and other Rotifers provided with this organ. It is in the form of a cup prolonged at the mouth into an incurved beak, as represented in figures 1–4. It is retractile and protrusile, contractile and expansile. When protruded and expanded the mouth gapes widely, and the beak becomes more extended, but always remains incurved. The mouth is bordered by a delicate membrane extending to the rounded end of the beak and presenting a festooned appearance. In contraction of the mouth the marginal membrane becomes inflected, the orifice constricted, and the beak more incurved. In contraction of the head or oral cup, it is reduced to half the bulk of its expanded condition, while the mouth is constricted and the beak is rolled in a single spiral inwardly as seen in figures 2, 3.

The extension of the head below forms a narrowed and transversely wrinkled neck which expands into the body. The expansion and contraction of the head appear to be due to the [redacted]

ope. The jaws are composed of a parallel series of about twenty eth.

The body of the animal is fusiform or elliptical and narrows to a long tail, attached by the end. In contraction, the body nd tail become more or less wrinkled transversely, as in *Megalo-ocha.* The tail is occupied by retractor muscles extending from he walls of the body. The cavity of the latter is occupied by a spacious stomach, elliptical in shape and extending from the mastax to the root of the tail, but its mode of termination I did not letect. The anal aperture occupies a position near the latter, but ts exact character I also failed to determine. The interval of he stomach and wall of the body is occupied by the ovaries and ova. In the vicinity of the lower extremity of the stomach there were several yellow spherical balls; a large one with concentric ayers, and several small ones apparently of the same nature. The character of these I could not make out. An ovum was observed to be discharged in the vicinity of the anal aperture, but its outlet was not distinguished. The ova are large and oval, and exhibit no signs of segmentation at the time of extrusion.

The embryo, figs. 5, 6, developed in the egg exterior to the parent, at the time of its escape is a soft worm-like body, with a blunt head end and tapering behind to a rounded tail end in the dorsal view. The head end, not distinct from the body, is retractile; and the terminal mouth is furnished with vibratile cilia, which are also retractile. The posterior part of the body is indistinctly divided and is retractile in a telescopic manner. In the lateral view the tail end appears slightly notched or furcate, with one branch longer than the other. The head exhibits a pair of minute red eye-points, and a short distance behind, it presents a minute pointed papilla, with a still more minute bristle at the summit. The embryo swims and moves about very much in the manner of the common Rotifer, often adhering by the tail end, retracting head or tail and successively elongating.

The chief distinctive characters of the animal thus described are as follows:

Acyclus inquietus.

Body fusiform, tapering behind into a long narrow tail-like appendage, by which it is attached, not distinctly annulated, but becoming transversely wrinkled in contraction. A non-ciliated cup-like head prolonged into an incurved digitiform appendage

(as a substitute for the usual trochal disk), contractile and retractile.

Length of the animal from 1·2 to 1·5 mm.; breadth of body 0·15 to 0·21 mm. Length of head, with moderate extension of the digitiform appendage, 0·216 to 0·27 mm.; breadth, 0·15 to 0·18 mm. Ova, 0·1 to 0·133 long, by 0·06 to 0·09 mm. broad. Embryo, 0·36 mm. long by 0·06 wide at the head end.

With the figures of *Acyclus*, for comparison with this and other Rotifers devoid of trochal disks which have been described, I have given one, fig. 7, of *Dictyophora*, drawn from observation of the animal some years subsequent to its discovery. The creature was attached to objects in, and to the inner surface of, an aquarium and could not be examined advantageously; and I had deferred my investigation of the animal to a more favorable opportunity. Under the circumstances the drawing must be viewed as only approximately correct. As previously indicated, the original description of *Dictyophora vorax* occurs in these Proceedings for 1857. Since then I have had several opportunities of observing it, and it appears readily to be introduced and reproduced in an aquarium with water and aquatic plants from the rivers of our vicinity.

Dictyophora is oval or ovoid, with the narrower pole, corresponding with the position of the mouth, truncated, and it adheres by a small disk or sucker to one side of the broader pole. The animal has the power of turning on its point of attachment, but whether it has the power of detaching itself at any time I did not ascertain, though the same individual appeared after some days not to have changed its position.

The body is transparent, colorless, and even, and exhibits no signs of annulation, nor does it become transversely wrinkled by contraction. The external chitinous wall presents an appearance of scattered granules or minute tubercles. The interior exhibits the digestive apparatus and other organs, mostly more or less obscured by an accumulation of eggs in various stages of development.

From the truncated extremity of the body, the animal projects a capacious delicate membranous cup, forming more than half a sphere and more than half the size of the body. At will the cup is entirely withdrawn into the body and the orifice of this becomes contracted and puckered into folds radiating from a central point

or orifice. When protruded the cup expands outwardly like an opening umbrella, and when fully expanded equals the breadth of the body with more than half its depth. It is provided with an irregular reticulation of delicate muscles, mostly longitudinal and a few transverse, and scarcely distinguishable from wrinkles. Other muscles, acting as retractors, extend from the membranous cup to the inner wall of the body of the animal. The cup or net substitutes the ordinary trochal disks of Rotifers and appears as a most efficient means in catching the animalcules which serve as food to *Dictyophora*.

The prehensile cup opens into a capacious sac which is within the body and occupies a good portion of its upper half. The sac at bottom communicates with a mastax nearly central in position. This is provided with a pair of jaws each consisting of a larger tooth and a vertical series of four smaller ones. The jaws are observed to be in frequent motion, as usual in Rotifers.

The mastax opens into a capacious sacculated stomach of a brownish or yellowish color. The outlines of the different portions of the alimentary apparatus are difficult to make out from their being more or less obscured by the ova with embryos contiguous to them. Muscular fibres pass from the viscera to the outer wall of the cœlum, or body-cavity. Adherent to this wall there are situated at different points whitish bodies, similar to those seen in other animals of the class, the nature of which is unknown.

Numerous ova, in all conditions from the earliest to those which contain fully developed embryos, occupy the body-cavity of *Dictyophora*, sometimes in such numbers as to obscure everything else from view.

Various specimens of *Dictyophora* with extended cup measured from 0·6 to 1 mm. in length. Closed specimens from 0·35 to 0·6 mm. long by 0·28 to 0·5 mm. broad. Ordinarily the body measured from 0·45 to 0·6 mm. long by 0·35 to 0·5 mm. broad. The cup in several ranged from 0·26 to 0·5 mm. both in height and breadth.

The animal is exceedingly sensitive, and with the slightest disturbance withdraws its net. It feeds especially on smaller animalcules, and in one instance upwards of fifty of these were squeezed from the stomach.

From *Apsilus lentiformis*, which *Dictyophora* closely resembles,

it differs especially in the absence of the lateral antennæ, and the conspicuous ganglion of the cephalic cup.

While *Lindia*, *Taphrocampa* and *Balatro* may be open to the suspicion of possessing ciliary rotiform disks, which perhaps were concealed when the animals were observed, the same cannot be the case with *Dictyophora*, *Apsilus* and *Acyclus*.

As remarked by Mr. Forbes, the former name had been preoccupied; and thus if the *Cupelopagus* should prove to be the same, this name may properly supply its place.

REFERENCES TO PLATE II.

Figs. 1–6. *Acyclus inquietus.*

Fig. 1. The animal extended, enclosed with eggs, in a gelatinous sheath. Magnified 96 diameters.

Figs. 2, 3. Different degrees of contraction of the head-cup. Magnified 96 diameters.

Fig. 4. Anterior view of the head-cup. Magnified 166 diameters.

Figs. 5, 6. Front and side view of the embryo. Magnified 80 diameters.

Fig. 7. *Dictyophora vorax.* Animal with its head-cup extended. Magnified 75 diameters.

October 10.

The President, Dr. Leidy, in the chair.

Twenty-three persons present.

A paper entitled "Snares of Orb-Weaving Spiders," by the Rev. Henry C. McCook, was presented for publication.

October 17.

The President, Dr. Leidy, in the chair.

Twenty-six persons present.

On the Mode of Entrance of the Sporidia of Parasitic Fungi.—Mr. Thomas Meehan exhibited specimens of *Panicum sanguinale* L., the "Crab-grass" or "Fall-grass" of the Northern States, which were infested with a species of smut, according to Mr. Ellis allied to *Ustilago juncei*,[1] but which were of interest chiefly for the light they might throw on the still disputed question, whether the sporidia of the lower forms of fungi were introduced to the infested plant from the outside, or in some way through the circulatory system. There seemed to be some difficulties in the way of the belief that the introduction could be through the roots, and the spores find their way through the plant-structure to the surface—and yet there were some positive facts on record, which, unless controverted, showed, impossible as it might seem from a physiological and structural point of view, that there were good reasons for that belief. He referred to papers by Dr. E. Queckett, in the "Transactions of the Linnæan Society," especially the one published in vol. xix, p. 137, detailing experiments with potted plants of rye and other grains watered with water in which the sporidia of the ergot had been infused. The plants so watered in every case reproduced the ergot in the grain of the growing plants—and in no case did ergot appear in the plants which had ordinary water applied to them.

The case now exhibited tended to strengthen the observations of Queckett. Usually specimens of affected grass might be found where the herbage was growing in a mass, and a person could not tell whether the specimens were all from one plant or not. In this case the specimens of *Panicum* were all growing in a cultivated field, and in tufts distinct from one another. The plant from

[1] Since this communication was made, Mr. Ellis identified the fungus with *Ustilago Rabenhorstiana*.

which these specimens were gathered, was surrounded by other the culms of these surrounding ones interlacing those of the plan exhibited, but only this one plant was infected. He did not coun the number of culms, but felt safe in saying there were over fift In walking through this field among many hundreds of plants this *Panicum*, he saw only one other plant, which in like mann was infested. This had one perfect panicle only among th numerous infested ones—the interlacing branches of surroundi plants of the same species being free, as in the other instan It was scarcely credible that sporidia of the *Ustilago*, floati through the atmosphere, settled on fifty separate culms of o plant, and not one on the culms of adjacent plants which we growing in and among them. Again, the leaves of the *Panic* have a large spathaceous sheath, two or three inches long. T *Ustilago* attacked the panicle while closely swathed in this shea and fully perfected its growth entirely therein. He had inde to unfold the sheath in order to detect the mass of "smut" which the embryonic panicle was reduced, in order to detect presence. Only the peculiar appearance of the grassy tuft havi no inflorescence as in the case of its neighbors, drew attention the plant in the first instance. If it seemed incredible that fi culms interlocked with as many from other plants, should e receive a germinating spore alone, it was still more incredible t the spores should have found their way from the outside to interior of these tightly twisted sheaths.

These observations did not prove that the sporidia entered plant by the roots, and made their way in some incomprehensi manner through the structure to the inflorescence; but they render the external-entrance hypothesis doubtful, and, in connect with Queckett's experiments, are possibly of some worth.

Dr. LEIDY made some remarks on Mr. Meehan's communicati showing that the tendency of modern observations rather favo the view that the entrance of the sporidia of microscopic fu was from the outside.

Sexual Characters in Cephalotaxus.—Mr. MEEHAN exhibi some fruit of *Cephalotaxus Fortunii*, a Chinese tree, this pl growing on the grounds of P. J. Berckmans, at Augusta, Geor This tree had for many years produced male flowers only. Dur 1882, it produced abundance of fruit. It showed that the ge was not truly diœcious, and further it afforded an illustrat now not uncommon, that trees a long time of one sex only, wo sometimes change to another. Sex is not an invariable cl acteristic in an individual tree.

A New Infusorian belonging to the Genus Pyxicola.—P LEIDY exhibited drawings of an infusorian, a species of *Pyxic* which appeared to be different from those previously descri

It is of frequent occurrence, attached to the tubes of *Plumatella*, *Urnatella* and *Cordylophora*, on stones, in the Schuylkill River, below Fairmount dam. In shape it resembles *Pyxicola pusilla* and *P. affinis*, fresh-water forms of England, but is annulate as in *P. socialis*, a salt-water form. It is represented in figs. 8 and 9, Pl. II, and presents the following characters:—

PYXICOLA ANNULATA. Lorica urceolate, slightly curved, inflated towards the middle, tapering below, cylindrical and feebly contracted at the neck, and with the aperture oblique and circular; variably annulate, mostly at the neck, often at the middle; color chestnut-brown, but colorless when young; pedicle short, always colorless. The contained animalcule is of the usual shape; with an attached operculum, which is of the same color as the lorica, and is protruded beyond this when the animal is fully extended. Length of lorica, 0.52 to 0.792 mm.; breadth, 0.02 to 0.0264 mm.; length of pedicle, .004 to .008 mm.

The following was ordered to be printed:—

SNARES OF ORB-WEAVING SPIDERS.

By Rev. Henry C. McCook,* D. D.

The characteristics upon which the true spiders should be classified into principal groups have not been agreed upon by araneologists. Without entering upon the discussion I have accepted the arrangement of Prof. Thorell of Upsala, which is substantially that of Latreille, and is based upon the spinning habits of the animal. That it is open to objection, can readily be shown; but on the whole it appears more satisfactory than any other. In accordance with this arrangement we have two great groups or divisions; *first*, the Sedentary Spiders, whose habit is to remain (for the most part) upon or in their web and capture their prey by means of snares; *second*, the Wandering Spiders, who hunt their food upon the ground, the water or trees. The first division is subdivided into sections according to the general character of the web; the second, according to the chief peculiarity of the spider's action or gait.

The following tabulated statement will present this arrangement:—

CLASS ARACHNIDA.

ORDER ARANEA.

I. *First Division.*

Sedentary Spiders.

Section 1. Orbitelariæ, Orb-weavers.
" 2. Retitelariæ, Line-weavers.
" 3. Tubitelariæ, Tube-weavers.
" 4. Territelariæ, Tunnel-weavers.

II. *Second Division.*

Wandering Spiders.

Section 5. Citigradæ,[1] Citigrades.
" 6. Laterigradæ, Laterigrades.
" 7. Saltigradæ, Saltigrades.

[1] Prof. Thorell assigns the Laterigrades to the 5th section, the Citigrades to the 6th. I have ventured to so far change this arrangement as to reverse the positions of the Laterigrades and Citigrades. The Citigrades appear to me to approach the Tubeweavers, both in structure and economy, more nearly than the Laterigrades. So also the step from the Citigrades to the Laterigrades though the genus *Dolomedes* appears more natural

This arrangement, based in the main upon the economy of the animal, will be found to harmonize closely with the classification into families, genera and species based upon structural characteristics.

I propose in this paper to apply this principle of arrangement according to economy to the first section of the Sedentary Spiders—the Orb-weavers. It should be understood that the classification proposed is simply tentative, and in its present form is incomplete. It is given with the hope that it may lead to something better by fixing the attention of the very few students of our spider-fauna, among whom no such grouping has hitherto been proposed. Moreover, it is hoped that the arrangement may have some interest to naturalists generally as bearing upon the correspondence between structure and economy and the value of habit as a factor in classification.

An orb-web may be defined as a series of right lines radiating from a common centre, and crossed at intervals by other right lines attached at the points of contact and covered by viscid beads. Orb-webs are divided generally into Vertical snares and Horizontal snares, according as they are perpendicular to, or parallel with, the plane of the horizon. The Vertical snares I have subdivided into (1) Full Orb, (2) Sectoral Orb, (3) Actinic Orb, (4) Orb Sector; the Horizontal Snares into (5) Plane Orb, (6) Domed Orb. I present the following table:—

ORB-WEAVERS' SNARES.

I. VERTICAL SNARES.

Snare spun vertically; spider hanging at the centre of the converged radii, or in a silken or silk-lined den.

1. Full Orbs.

Lines crossing all the radii spirally. (Forming complete circles.)

i. *Simple Snares.*—Simple orb of radiating straight lines and concentric circles.

a. The hub meshed. *Epeira insularis*, *E. strix.*[1]

b. The hub open; central space ribboned or tufted. *Acrosoma rugosa*, *A. spinea*, *A. mitrata*, *Gasteracantha cancer.*

than the reverse, as Thorell has it; and the step to the Saltigrades from the Laterigrades is quite as, if not more, natural than from the Citigrades. From the standpoint of economy alone the passage is certainly easier.

[1] These are representative species of a large group.

c. The central space ribboned, cocoons and debris attached to the ribbon. *Cyrtophora caudata.*

ii. *Compound Snares.*—Orb partly surrounded by an irregular mass of crossed lines.

a. Central space sheeted or ribboned; wings or guards of crossed lines. *Argiope riparia, A. fasciata.*

b. Hub meshed; mass of line-weaving above containing the spider's home and cocoons. *Epeira labyrinthea.*

2. Sectoral Orb.

Radii crossed by lines forming nearly complete circles.

i. *Simple Snares.*

a. Hub meshed (?); the beaded spirals divided into bands by an unbeaded line and space. *Nephila plumipes.*

ii. *Compound Snares.*

a. Hub meshed; tubular den or tent in the retitelarian web. *Epeira globosa, E. thaddeus.*[1]

3. Actinic Orb.

Snare composed of several rays or orb-sectors bound together into an orb.

i. *Simple Snares.*

a. Hub wanting; a large, irregular, open central space. The radii prolonged into a trap-line. *Epeira radiosa.*

4. Orb Sector.

Snare, a sector of an orb.

i. *Simple Snares.*

a. Sector composed of four radii converging upon a single trap-line; radii crossed by notched lines. *Hyptiotes cavata.*

II. HORIZONTAL SNARES.

Snare spun horizontally; spider usually hanging beneath.

5. Plane Orb.

Snare, a circular plane.

i. *Simple Snares.*

a. Hub open. *Tetragnatha extensa; T. grallator.*

b. Hub finely notched; central space ribboned. *Uloborus riparia.*

ii. *Compound Snares.*—A maze of crossed lines spun below the orb.

a. Hub open. *Epeira hortorum; E. gibberosa.*[1]

[1] The generic classification of Hentz is here retained.

6. Domed Orb.

Snare elevated into a dome by a pyramidal mass of crossed right lines.

i. Concentric lines all notched; spider hanging beneath the centre. *Epeira basilica.*

Several technical terms in this table, which I have been compelled to invent, require explanation. I have divided an orb-web into three parts. *First*, beginning at the outer margin, the Foundation Space, the open space between the foundation lines or frame, and the beaded spirals; *second*, the Spiral Space, that part covered by the spiral lines; *third*, the Central Space, the central circle enclosed by the spiral space. The central space is subdivided into three parts, first the hub, the small open or meshed circle upon which the radii meet; second, the Notched Zone, a series of unbeaded spirals lying next to the hub which do not cross the radii directly, but a little above the point of contact; and third, the Free Zone, a part free from crossed lines between the notched zone and the spiral space.

FS=Foundation space.
SS=Spiral space.
CS=Central space.
FZ=Free zone.
NZ=Notched zone.
H=Hub.

OCTOBER 24, 1882.

Mr. JACOB BINDER in the chair.

Eight persons present.

On the Habits of the Ant-Lion.—Rev. Dr. H. C. McCOOK remarked that, through the kindness of Mr. C. H. Baker, he had had an opportunity to observe closely some of the habits of the larva of *Myrmeleon obsoletus* Say. Several of these grubs had been taken from the sandy soil of New Jersey during the month of July, and brought to the Academy at Philadelphia in a large bowl. Their pits were of the usual character—an inverted hollow cone—but were sharper at the apex than usually represented. The pit is sometimes made by a backward movement of the grub upon a spiral line which gradually closes upon the centre. The body is just under the sand during this movement; and the grains of sand which fall upon the head are continually thrown upward by a sharp jerk of the head; this motion is somewhat lateral, not unlike the "butting" of a sheep or goat.

A pit is also formed by the grub while stationary, the violent ejection of the sand by the toss of the head, causing a vortex towards which the surrounding sand runs from all sides, thus naturally forming the concavity. Within this the creature lies concealed, and at once begins to toss the sand when the surface at the margin is agitated by a crawling insect. Sometimes the head and jaws are exposed; they are laid flat (as observed in these cases at least), extending horizontally and not vertically

[redacted]

hairs of the body at many points. The inquiry was suggested whether there is any secretion or excretion from the grub which may produce this effect and so contribute to secure the victim.

The ants show a strange fascination for the pit, even after they have escaped. A large Carpenter ant (*Camponotus pennsylvanicus*) was seized, escaped, rushed out of the hole, then in and around it again and again, as though verily dazed. There is a vast deal of the "Paul Pry" in the emmet nature, but the ants were rarely observed to deliberately walk into the pit. They stopped upon the edge, when they reached it in course of their rambles about the bowl, threw up their antennæ and waved them restlessly, sometimes stretched a fore-foot over the brink, sometimes retreated, sometimes turned and began to circumambulate the pit. The agitation upon the sand, slight as it was, generally (not always) aroused the grub to action, and by the process already described, the sand was withdrawn from beneath the feet of the insect, who slid along with the tiny sand-avalanche into the apex. There it was seized unless, as sometimes occurred, it was fortunate enough to make its escape.

The use of the long hooked mandibles of the grub appeared in the act of seizure; the ants were held off "at arm's length," so to speak, and the grub thrashed or jerked them violently until they were exhausted. Meanwhile, the efforts at defense were made futile by the distance from any vital point at which the victim was held. *Tetramorium cæspitum*, the Pavement ant, which has a sharp sting, and tried eagerly to use it, was thus prevented from doing so and made quite defenseless. So also the formidable pincer mandibles of the Carpenter ant, by which she excavates her wooden galleries and decapitates her victims with the facility of a guillotine, are rendered entirely useless. This defenselessness is completed by the position of the grub beneath the sand. A Carpenter worker-minor seized by a hind leg bowed her body under to snap at her captor; but her jaws grasped only the gritty pellets of sand which covered the ant-lion's head and out of which the long hooks alone projected.

The point of greatest importance which Dr. McCook observed, was the confirmation of the statements of M. Bonet, concerning the behavior of the grub when its movements are obstructed by pebbles too large to be tossed out by the head. This statement having been seriously questioned,[1] the matter was tested by first dropping three pebbles, each larger and heavier than the larva within the centre of the pit. The grub having attempted to remove these in the usual manner, and failed, proceeded in this wise: It backed up to a pebble, and placed the posterior of the abdomen against, and a little beneath it, so that the sand readily dropped over the apex of the abdomen and lay between that and

[1] Rennie, Insect Architecture, p. 202. "We may be pardoned for pausing before giving full credence to these details."

the stone. A little adjustment was required to balance the pebble by getting its middle part against the end of the body, and then the animal began to back out of the pit, so pushing the pebble before, or rather behind it, up the side, and to a point a short way beyond the margin, where it was abandoned. A small furrow —two to three inches long—was described in the sand by the moving stone, which furrow was curved from the point of departure. The stone was kept perfectly balanced during the entire progress, which was quite rapid. Each of the three pebbles was thus removed, the grub returning each time and backing it out of the pit. The experiment was repeated a number of times and always with the same result. Some well-rounded stones were selected in order to make the difficulty of balancing greater, but this made no difference in the action of the larva, a round pebble being balanced and removed quite as readily as a flat one. It was a curious and amusing spectacle to witness the odd little creature thus backing the accurately poised impediments out of its domicile, and then returning to put its house in order once more. The correctness of the early observations of M. Bonet is thus fully confirmed by Dr. McCook's experiments.

OCTOBER 31.

The President, Dr. LEIDY, in the chair.

Thirty-six persons present.

The resignation of Dr. Chas. Schaeffer as Curator was received and accepted.

Actinosphærium Eichhornii.—Prof. LEIDY remarked that he had noticed in an aquarium what appeared to be eggs, adherent to the edges of the leaves of *Vallisneria*, from the Schuylkill River. On examining the egg-like bodies with a lens, they were observed to be covered with delicate rays. On transferring some of the bodies to the field of the microscope, they proved to be giant specimens of the larger sun-animalcule, *Actinosphærium Eichhornii.* They measured from three-fourths to one millimetre in diameter, independent of the rays, which extended from one-fourth to half a millimetre more. One of the smaller individuals contained four water-fleas, Daphnias, a third of a millimetre long, and one of the larger contained six of these. The *Actinosphærium* appears to be tenacious of life; several specimens having been retained alive and in good condition for three days, in a drop of water in an animalcule cage. They had discharged the Daphnias, but retained their original size. One of oval form measured 1 mm. long by 0.75 mm. broad. The smaller ones measured 0.75 mm. in diameter. After another day they appeared in good condi-

tion, but the rays were contracted so as to be about half the original length, and many had a minute granular ball at the end, apparently effete matter thrown off from them. At this time the animalcules were returned to the aquarium.

NOVEMBER 7.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

The following were presented for publication:—

"A review of Swainson's Genera of Fishes," by Joseph Swain.

"Ants as Beneficial Insecticides," by the Rev. Henry C. McCook, D. D.

The deaths of Benjamin V. Marsh and Isaac Comly, M. D., members, were announced.

On Topaz and Biotite.—Prof. LEIDY exhibited several interesting minerals. One of these was a large crystal of topaz, of dark and decided amethystine hue from Brazil. The yellow topaz is the common kind and this by heating assumes a pink or rose color. He had never seen or read of another of the same color. The crystal is about $2\frac{3}{4}$ inches in length. The other mineral consisted of plates of muscovite containing hexagonal plates of biotite remarkable for their regularity and beauty. The crystals of biotite ranged from a millimetre to 50 mm. in breadth. The specimens are from Macon Co., N. C. Similar specimens are found in West Philadelphia, but he had seen none from this locality in which the crystals of biotite were so regular.

NOVEMBER 14.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

The death of J. Norris Emlen, a member, was announced.

On Actinosphærium, etc.—Prof. LEIDY stated that *Actinosphærium Eichhornii*, on which he had made some remarks a few weeks ago, still existed in large numbers in an aquarium in his possession. The animals though in active condition appeared to be habitually sedentary, remaining adherent to the edges of leaves of *Vallisneria* and other aquatic plants, and often, as on a pedicle

to the ends of minute filamentous algæ growing from the former. The last few days he had observed a number apparently in conjugation, conspicuous for their larger size and elongated form. One apparently of two individuals was biscuit-shaped, 1.375 mm. long and 0.625 wide. Later, it assumed an oval shape and measured 1 mm. long and 0.875 wide. Another specimen, apparently of three individuals in a trefoil-like group measured 1.5 mm. long and 1.125 broad. Shortly after it assumed a biscuit form, with one lobe larger than the other and then measured the same length, with the same breadth on one side and 1 mm. on the other. Both of the above were transferred to an animalcule cage, and after twenty-four hours, three appeared in their place. One of these of lozenge shape with rounded angles measured 1.625 mm. long by 0.875 broad; a second was irregularly half-oval and 1.125 mm. long by 0.875 broad; and the third was oval and 0.75 mm. long by 0.625 broad. In the later observation they had discharged all conspicuous food.

Prof. Leidy further stated that on tubes of *Plumatella diffusa*, attached to a stone collected in the same locality as the above, he had noticed many specimens of the following forms of infusoria and rotifers.

Vaginicola crystallina.—Tube 0.1 mm. long, 0.028 broad; often containing two individuals.

Vaginicola tincta.—Tube 0.1 mm. long; at mouth 0.048 wide; just below 0.04 wide.

Limnias annulatus.—Tube 0.6 to 0.625 mm. long; 0.05 to 0.0625 wide; rotary disks together 0.2 wide.

On Tubularia, etc., from Atlantic City.—Prof. Leidy exhibited specimens of the hydroid *Tubularia crocea* (*Parypha crocea* Ag.), which he had observed in great profusion attached to the bottom of a wreck at Atlantic City, N. J. With it he had noticed a multitude of the little sea-slug *Eolis pilata* Gould, and the skeleton-shrimp, *Caprella geometrica* Say. He further exhibited specimens of *Alcyonidium ramosum* Verrill, presented by Mr. Edward Potts, and obtained by him from stones at the inlet of Atlantic City.

The following were ordered to be published:—

ANTS AS BENEFICAL INSECTICIDES.

By Rev. Dr. H. C. McCook.

Through the courtesy of Rev. H. Corbett, a missionary of the American Presbyterian Board, at Cheefoo, China, I received a copy of the "North-China Herald," of April 4, 1882, containing an article by Dr. Magowan, of Wenchow, on the "Utilization of Ants as Grub-Destroyers in China." From this paper I quote the following sentences:

"Accounts of the depredations of the coccids on the orange-trees of Florida, induce me to publish a brief account of the employment by the Chinese of ants as insecticides. In many parts of the province of Canton, where, says a Chinese writer, cereals cannot be profitably cultivated, the land is devoted to the cultivation of orange-trees, which, being subject to devastation from worms, require to be protected in a peculiar manner, that is, by importing ants from neighboring hills for the destruction of the dreaded parasite. The orangeries themselves supply ants which prey upon the enemy of the orange, but not in sufficient numbers; and resort is had to hill-people, who, throughout the summer and winter find the nests suspended from branches of bamboo and various trees. There are two varieties of ants, red and yellow, whose nests resemble cotton-bags. The 'orange-ant feeders' are provided with pig or goat bladders, which are baited inside with lard. The orifices of these they apply to the entrance of nests, when the ants enter the bags and become a marketable commodity at the orangeries. Orange-trees are colonized by depositing the ants on their upper branches, and to enable them to pass from tree to tree, all the trees of an orchard are connected by bamboo rods.

"Is the orange the only plant thus susceptible of protection from parasitic pests? Are these the only species of ants that are capable of utilization as insecticides? Indubitably not; and certainly entomologists and agriculturalists would do well to institute experiments with a view to further discovery in this line of research."

I propose to consider whether the suggestion here raised is entitled to serious attention by economic entomologists in the United States, as likely to lead to valuable practical results.

I. In the first place it might be asked, *Are the domicile habits of ants favorable?* Ants possessing the habit of the China emmets referred to by Dr. Magowan are comparatively rare, certainly not many are known to science. Mr. F. Smith, in his Catalogue of Hymenopterous Insects in the British Museum,[1] gives figures of several fibrous nests made by arboreal species of ants, *Crematogaster* (*Pachycondyla*) *montezumia*, from Mexico, *Polyrhachis textor*, from Malacca, *Formica gibbosa*, India, and *Crematogaster arboreus*, from Port Natal. One of these, it will be observed, is a North American species, the only one indeed of which I have any knowledge. An Australian species, *Crematogaster læviceps*,[2] builds a pensile nest somewhat in the fashion of our hornet, upon trees. It contains a labyrinth of curved galleries and cells centering upon the interior. *Formica bispinosa*, of Cayenne, forms a nest of cottony matter from the capsules of Bombax.[3] In Brazil, this species, the *Polyrhachis bispinosus*, is popularly known as the "Negro-head Ant," the globular nest, covered on the exterior with little projections, being suggestive of close wooly hair. Smith says that the material of which it forms its nest, furnishes an article of commerce used as tinder, for lighting cigars, etc.[4] *Myrmica kirbii*, an India species described by Lieut. Col. W. H. Sykes,[5] which is apparently a species of *Crematogaster*, makes a formicary in the branches of trees out of the droppings of cows. These it spreads in thin, flaky, overlapping folia, like shingles or tiles. A dome-like roof covers the summit in an unbroken sheet, like a skull-cap on a man's head. The interior consists of a multitude of irregular cells, formed of the same material as the exterior. The "Green Ant," *Œcophylla virescens*, builds an arboreal nest of dead leaves, from which it often drops down in bevies upon travelers, very much to their discomfort. The nest is about eight inches in diameter, and is made of a leaf-pulp—as the hornet's nest is of a pulp of wood-fibre—and is hung among the thickest foliage, being sustained not only by the branches, but by the leaves which are wrought into the nest, and in parts project from the outer wall. Mr. Foxcroft discovered an

[1] Part vi, Formicidæ, Plates I, II, XIV.

[2] Smith, Catal. Brit. Mus., vol. 15, Formicidæ, p. 138.

[3] Lubbock, 1882, "Ants, Bees and Wasps," p. 24.

[4] Trans. Entomol. Soc., Lond., Ser. iii, vol. i, p. 32, 1862.

[5] Trans. Entomol. Soc., Lond., *id.*, p. 101.

African species of *Œcophylla*, which, when disturbed, swarmed in excited legions upon the outside of their papery domicile, against which they pattered so vigorously, as they moved, that the observer thought the rain was falling upon the leaves above.[1]

These are all exotic species. and I know of no American (U. S.) arboreal ants except those, like the various species of *Camponotus*, for example—the Carpenter ant—that live within the excavated wood. Any protection to the fruit wrought by these would be neutralized by the injury done the tree itself. Certain species of ants have also been reported as dwelling in the hollow interior of the spines that grow upon some of our thorny trees, like those referred to by M. Ernest André in his admirable work now going through press.[2]

Mr. W. H. Patton has described an indigenous species, *Stenamma gallarum*, as inhabiting a gall upon a dead but unbroken stock of golden rod.[3]

Ants are indeed often seen in great numbers upon trees, and moving in columns up and down the trunk and along the branches; but such are engaged in seeking food from aphides, coccids, galls, etc., and usually have their domiciles elsewhere, for the most part underground.

Mr. Smith describes a species (*Pseudomyrma modesta*), collected in Panama, which nests in the spines of a species of Acacia. The spines are three inches long, and the entrance to the formicary is a small hole gnawed near the point. There are no cells within, and this is probably (as the similar cases alluded to may be), simply an example of "squatter sovereignty."[4]

We do have indigenous ants with the habit of constructing nests of leaf-pulp, in the manner of the China species, as for example *Atta fervens* Say, and *Atta septentrionalis* McCook, heretofore described in these Proceedings. *Atta fervens*,[5] the Leaf-cutting or Parasol ant strips the leaves of various trees, reduces them to pulp, and forms nests rudely resembling those of the hornet. These nests, however, are underground, and not upon trees. As I have seen them in Texas hanging to the roots of an immense

[1] Wood, "Homes without Hands," p. 270-3.

[2] "Species des Formicides d'Europe," p. 52.

[3] Amer. Naturalist, Feb., 1879, p. 126.

[4] Trans. Ento. Soc. London, vol. i, ser. 3, p. 33.

[5] Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 33.

live oak-tree, or built up from the floor, or attached to the roof of their large subterranean caves, they quite resembled the pensile nests of the tree-ants as described by various writers. *Atta septentrionalis*[1] is a New Jersey species, and builds out of the leaves of pine nests which are little models—almost toy-like in their minute mimicry—of the Texas species. These, too, are underground, and although they have the requisite ability as to nest-making, the problem of domesticating them in the tree-tops could hardly be solved, even by an economic entomologist. It may be concluded, therefore, that if a domicile in the trees, as with the China species, be a necessary condition, we have no indigenous species upon which to experiment, either to utilize or develop a habit that will make ants so highly beneficial as insecticides as to justify any dependence upon them as protectors of fruits.

II. In the second place we may ask: *Is the food-habit of ants favorable?* Undoubtedly ants are insectivorous, or carnivorous, rather. Their food-supply is largely drawn from insects yielding sweet excretions or secretions; from the nectar and sugary exudations of plants, from fruits, from the oils of nuts, seeds, etc. They are also largely scavengers. Dead insects and animals of all kinds, refuse of many sorts afford them nutrition, but they do not limit their insectivorous tastes to mere scavenger work: they also prey upon living insects. This is true of our indigenous ant-fauna, although we have no such wholesale insecticides as the famous Eciton or Driver ant of Africa and South America, whose raiding columns clear out every living insect within their broad sweep.[2] I have seen the Mound-making ants of the Alleghenies (*Formica exsectoïdes*) preying upon our native Termite or White ant, *Termes flavipes*,[3] when the nests of this insect had been uncovered by turning up stones upon the mountains in search of specimens. It was surprising to note how quickly the Formicas appeared on the scene, seeming to dart out from behind every blade of grass, stick and stone, and leaping into the galleries that threaded the flat pit of the stone, seized with avidity the soft white Termes and made off with their prey. These ants and many

[1] Proceed. Acad. Nat. Sci. Philada, 1880, p. 359.

[2] See a full account in Belt's "Naturalist in Nicaragua," p. 17, seq., and "Naturalist on the Amazons," vol. ii, p. 350.

[3] Proceed. Acad. Nat. Sci. Philada., 1879, p. 154.

others have been seen capturing flies,[1] even on the wing, and frequently bringing home to their nests various insects, still living or recently killed.

So also the Agricultural ants of Texas,[2] have been seen after a shower to break suddenly out of their formicary, scatter throughout the foliage and return with immense numbers of living insects beaten down by the hard rain.

Forel[3] says that throughout the bounds of an ant-city of *Formica exsecta*, in Switzerland, covering many acres, he was not able to discover any other species of ant except a few nests of *Tetramorium cæspitum*, who owed their exemption to their superior agility. This is true in some measure of the allied *F. exsectoïdes*, in our mountains and the New Jersey barrens. In addition, it may be stated that ants are veritable cannibals, destroying and feeding upon not only individuals of their own family, but those of their own species. In the same connection may be mentioned a custom of American Indians to put furs and blankets infested by insects near the mounds of the Occident ant, in order to have them cleaned out by the insectivorous emmets.[4] So far, therefore, as the mere food habit is concerned, it is favorable to the idea of utilizing certain species of ants as insecticides.

III. A *third* question may be raised, viz.: *Do our ants exhibit in nature any special insectivorous habits that would make them natural protectors of crops?* This question has been considered at some length by the Agricultural Department of the United States Government in the matter of the cotton crops. In a report on Ants, prepared at the request of that department,[5] the writer reviewed the testimony gathered from many and widely separated sections as to the friendly offices of ants in destroying the eggs and larva of the cotton-worm. My opinion then was that, on the whole, those offices would hardly have an important commercial value, although to a certain extent beneficial. Many of the practical observers from whom information was collected, spoke highly of the services of the ants, especially of one, "the Cotton

[1] Mound making Ants of the Alleghenies, p. 259.

[2] Agricultural Ants of Texas, p. 108.

[3] Les Fourmes de la Suisse, p. 207.

[4] Honey Ants of the Garden of the gods, and Occident Ants of the American Plains, p. 151.

[5] Comstock's Report upon Cotton Insects, 1879, p. 181, seq.

Ant," *Solenopsis xyloni* McCook. These ants were particularly effective against the eggs, but attacked the larva also. So good an observer as Mr. Trelease ventures the opinion that ants are probably among the most important enemies of the cotton-caterpillar. One observer went so far as to think that the ants would ultimately destroy the cotton-worm, should it prove to be indigenous rather than of foreign origin.

All the ants considered in the above-named report are mining ants, and would therefore not be available for such uses as the species of the Chinese orangeries. There appears to be no good reason, however, why they might not be useful on the orange-trees of Florida, to which State some of them are native. But it would be a necessary condition, I think, that the ants should exist in such vast numbers as to compel, under the stimulus of hunger, a thorough canvassing of every neighboring object that might shelter available prey. The value of the Chinese Orange ants appears to turn upon such conditions, viz.: their limitation to tree surfaces as a foraging field, and their vast numbers. In short, a limited supply of food and an immense demand for it, constrain the ants to the most diligent garnering and careful gleaning. On the whole there is little hope that these conditions can be met by artificial domestication of American ant fauna.

IV. *Would it be practicable to domesticate the Chinese species in America?* In answering this question I can venture no opinion [redacted]

is distributed throughout the tropical and sub-tropical regions of the entire world.[1]

In view of these facts, there is a probability, at least, that the tree-ants of China might be introduced and domesticated. Whether *such* "Chinese migration" would be encouraged by an American Congress might have to be considered! And perhaps it would require the patience and skill of the Chinese *men* to successfully domesticate Chinese *ants*—could that be done at all.

In the same connection it may be said that some of our indigenous species have a remarkable elasticity of organism by which they are adapted to the widely varying climatic and geographical conditions of our country. For example, both the Red and Shining Slavemakers which inhabit the Atlantic coast, I have found in the Garden of the gods, Colorado.[2] Several species of the Carpenter ants are distributed throughout our forests from Maine to California, notably *Camponotus pennsylvanicus*, which I have found not only in our Eastern mountains, but in sub-tropical Texas. Prof. Aug. Forel[3] has examined specimens from New Orleans, and California, as well as from China, Japan and Siberia. Throughout all these regions it has precisely the same habits as described by the writer.[4] *Formica fusca*, which so often appears as a domestic ally or "slave" of the kidnapping species, is widely distributed over our continent, and is substantially identical with the species of the same name found nearly everywhere in Europe.

On the other hand, some ants have well-marked geographical limits which have not yet been overcome by natural movements. The Occident ant (*Pogonomyrmex occidentalis*), I have traced[5] approximately within a range of 13° latitude, say from 45° N. to 32° N.; and of 21° longitude, that is, from Brookville, Kansas, to Reno, at the base of the Sierra Nevada, 1622 miles west of the

[1] Catalogue des Formicides d'Europe, by Forel & Emory. Mittheilungen der Schweiz. Entom. Gesellsch., Bd. 5, Heft 8. Schaffhausen, Alexander Gelser, 1879.

[2] McCook, "The Shining Slavemakers," Proceed. Acad. Nat. Sci., Phila., 1880, p. 376, seq.

[3] Forel, "Etudes Myrmécologiques En.," 1879. Bull. Soc. Vaud. Sc. Nat. xvi, 81, p. 858.

[4] Trans. American Entom. Soc., vol. v, 1874-76, p. 277, seq.

[5] McCook, "Honey and Occident Ants," p. 125.

Mississippi River. There appears to be no satisfactory reason (from a human standpoint) why these insects should not have pushed eastward much further; but some cause (quite satisfactory from an emmet standpoint) seems to have marked their bounds in the very midst of the great plains. So also the Cutting ants are—fortunately for the agriculturists—even more sharply limited to the southwest; and within the same geographical province, but with a little more elastic margin, to which the Honey ants (*Myrmecocystus melliger*) are confined. Not to multiply examples it thus appears that the question of importing and domesticating beneficial emmet insecticides is conditioned and may be prevented by the creatures' peculiar organism. The Chinese tree-ants are apparently natives of the South, the province of Canton, and it does not appear from Dr. Magowan's paper whether they have been also utilized in the northern provinces. Their domestication in our Southern States would, therefore, be favored by similar climatic conditions. Independent of such considerations, there are always natural checks and helps to the increase of insects, often of a nature so extremely complicated with other species of animal-life and the plant-world, either hostile or friendly, that experiment alone can positively determine such a result.

In answer to the question, "Could ants be transported so far with a view to trying the experiment?" I would say that I think the matter practicable. I brought several artificial colonies of Honey ants from Colorado to Philadelphia, carrying them in glass jars, feeding them a little water and sugar. These were kept during the fall and winter, but as the purpose was only to observe their habits, no effort was made to domesticate them. Large numbers of workers of the Agricultural ants were sent to me from Texas through the mails, arriving in good condition, and living throughout the winter. They were not permitted to live longer, as I did not consider myself at liberty to introduce, for other than mere experimental purposes, any insect that might possibly become injurious. Similar attempts to obtain colonies of the Cutting ants, all failed, these insects evidently not having the same vital power, at least for such conditions as a tin box and a mail-bag, as the agriculturals.

Shipments of ants from China I believe could be made, by placing workers, larvæ, eggs, and, if possible, a queen, in roomy boxes containing portions of their nests, perhaps also a little soil,

and covered with close wire-cloth. They should be fed, not too freely, with animal fats and sugar, and given water in a sponge, soaked cork, or cloth. With care there seems to be no reason why such artificial formicaries should not be safely transported from China.

In conclusion I wish to say that whatever benefits the ant may be led by domestication to confer upon man, she already is entitled to consideration as a valuable, if not valued, friend of the race. I have elsewhere shown[1] that ants fill an important place in the economy of Nature by contributing to the fertilization of the earth. In the paper referred to it appears from measurements of the amount of soil actually excavated, that insignificant in size as these insects are, the labors of countless hosts through many years are by no means insignificant in the shifting of the soil. They pulverize the ground and bring it in great quantities to the surface, thus making good topsoil for the growth of vegetation. In addition to this it is shown that the ants bring about the aëration of the soil, so needful for its productiveness. Moreover, the system of "pores" established by the galleries which everywhere perforate the ground, affords, on the one hand, free entrance for the rains into the earth, and on the other hand a series of tubes through which, by capillary attraction, the moisture may ascend to the roots of the plants. The last work of Dr. Charles Darwin[2] is devoted largely to similar habits on the part of the earth-worm; and in view of the interest which that subject has elicited, I venture to again call attention to the distinguished service wrought for the benefit of agriculture by the industrious ant. Even if that insect should not be as tractable for domestication as her Hymenopterous ally, the bee, and in spite of her occasional forays upon our cupboards and crops, the ant is worthy to stand at the head of insects beneficial to man.

N. B.—Since the above was in press I have observed that Dr. Forel, in his "Etudes Myrmécologiques" for 1879, speaks of a Mexican species of *Camponotus* (*C. senex*), in the collection of Saussure, as bearing a label inscribed "Nids de papier dans les branches"—Nests of paper in the branches. This and *Pachycondyla montezumia* make two known North American species of Tree-ants.

[1] Proc. Acad. Nat. Sciences, 1879, p. 158, seq.

[2] The Formation of Vegetable Mould through the Action of Earthworms, 1882.

A REVIEW OF SWAINSON'S GENERA OF FISHES.

BY JOSEPH SWAIN.

In the year 1839, William Swainson published a general scheme of the classification of Reptiles, Amphibians and Fishes,[1] in which all the accepted genera of these groups are defined and a list of typical, or illustrative species is appended. Many new generic names are here introduced, the consideration of which forms the object of the present paper. I give a list of the new generic names proposed for Fishes by Swainson, with their equivalence in modern nomenclature, as I understand them. The list of species referred by Swainson to each genus is here repeated verbatim, the species considered by me as the type of each group being indicated by an asterisk (*). The whole work is singularly worthless as a contribution to science, and of interest only from the fact that the law of priority requires the adoption of many of these names.

It may be observed that Swainson possessed a very limited knowledge of Fishes. His definitions are seldom apt and very often incorrect, and but a small proportion of his genera can be received into the system. Of these few, scarcely any retain their original definition.

All difficult questions, involved in this paper, have been referred to Prof. D. S. Jordan, and to whom I am also indebted for other valuable suggestions, and for the use of his library. I am likewise indebted to Prof. C. H. Gilbert for kindly aid.

Cromileptes,[2] p. 201 = **Epinephelus** Bloch (about 1790).

C. altivelis Sw. Cuv., pl. 35. myriaster Rüp. (nec Cuv.), i. pl. 27, f. 1.
gigas,* Ib., pl. 33.
C. miniatus, Rüp. i, pl. 26, f. 3. fuscoguttatus, Ib. f. 3,
hemistictos, Ib. f. 3.

[1] The Natural History of Fishes, Amphibians & Reptiles, or Monocardian animals. By William Swainson, F. R. & F. L. S. * * * In two volumes. Vol. II. London. Printed for Longman, Orme, Brown, Green & Longmans, Paternoster Row, and John Taylor, Upper Gower Street, 1839.

[2] The name *Cromileptes* has been lately revived by Dr. Bleeker (Sys. Perca. Revis. Pars 1 a, 11, 1875), in place of his own *Serranichthys*, the type of which is *altivelis*. As, however, this species does not agree with the

Cynaichthys, p. 201 = **Plectorhynchus**[1] Lacépède (1800.)
C. flavo-purpuratus.* Frey, Atl. pl. 57, f. 2. Bennet, Ceyl. Fishes, pl. 19 (fig. 42 c).

Variola, p. 202 = **Variola** Sw. (1839).
V. longipinna* Sw. Rüp. i, pl. 26, f. 2 (*S. louti* Rüp.).

Elastoma, p. 202 = **Etelis**, C. & V. (1828).
E. oculatus* Sw. Cuv., pl. 32.

Uriphæton,[2] p. 202 = **Variola** Sw. (1839).
U. microleptes* Sw. (Serranus phæton, Cuv. pl. 34).

Rabdophorus, p. 211 = **Chætodon** L. (1758), subg. **Rabdophorus** Sw.
Ephippium* Sw. Cuv. pl. 174.

Genicanthus, p. 212 = **Holacanthus** Lac. (1803).
Lamarckii,* Cuv. pl. 184. tricolor, Bloch, pl. 426.

Microcanthus, p. 215 = **Chætodon**, L. (1758).
G. strigatus,* Cuv. pl. 170.

Microgaster, p. 216 = **Etroplus** C. & V. 1830.
maculata,* Cuv. pl. 136.

Chrysiptera, p. 216 = **Glyphidodon**, Lacépède (1802).
azurea,* Frey, Atl. pl. 64, fig. 3. Gamardii, Ib., fig. 4.

Chætolabrus, p. 216 = **Etroplus**, C. & V. (1830).
Suratensis,* Bloch., 217. maculatus, Ib., 427.

Chrysoblephus, p. 221 = **Sparus**, L. (1758.)
C. gibbiceps,* Cuv. pl. 147.

Argyrops, p. 221 = **Sparus**. L. (1758).
Spinifer,* Forsk. Russ. pl. 101.

Calamus, p. 221 = **Calamus** Sw. (1839).
E. megacephalus,* Sw. Cuv., pl. 152.

Lithognathus, p. 222 = **Lithognathus** Sw. (1839).
L. capensis,* Sw. Cuv., pl. 151.

Nemipterus, p. 223 = **Dentex** Cuv. (1817).
N. filamentosus,* Cuv., pl. 155.

diagnosis (not having a strong canine tooth on each side of lower jaw), and the other five species, which do so agree, belong to the prior genera *Epinephelus* and *Bodianus*, we should consider *Cromileptes* a synonym of *Epinephelus*.

[1] *Diagramma* Cuv., 1817.

[2] *Phæthonichthys* Bleeker. As has been shown by Dr. Vaillant, the *Serranus phæton* Cuv. and Val. was a made-up specimen, with the tail of a *Fistularia* skilfully fastened to the body of a Serranoid (probably a species of *Variola*).

Thalassoma, p. 224 = **Thalassoma** Sw. (= **Julis** Auct. *nec typus*).
T. purpurea,* Nob. Rüpp., Atl. pl. 6, fig. 1.

Urichthys, p. 224 = **Chilinus** Lac., (1802).
U. lunulatus,* Nob. Rüpp., Atl. pl. 6, fig. 1.
quinque-cinctus, Ib., ii, pl. 5, fig. 1.

Crassilabrus, p. 225 = **Chilinus** Lac., (1802).
C. undulatus,* Rüpp., Atl. pl. 6, fig. 2.

Leptoscarus, p. 226 = **Calliodon** Gronov. (1801).
L. vargiensis,* Quoy and Gaim, p. 288.

Hemistoma, p. 226 = **Scarus** Forskæl,[1] 1775.
H. reticulata, Sw. (Scarus pepo* Benn. Ceylon, pl. 28).

Petronason, p. 226 = **Scarus**.
P. psittacus*, Rüpp. pl. 20, 1.
Rüppellii, Ib., pl. 21, 1.
bicolor, Ib., pl. 21, 3.
longicauda, Ib., pl. 21, 2.
viridis, Bl., pl. 222.
flammiceps Bennett, Ceylon, Fish, pl. 24.
niger Rüpp. Atl. ii, pl. 8, 1.
collana, Ib., fig. 2.
pulchellus, Ib., fig. 3.

Erychthys, p. 226 = **Calliodon** Bloch and Schneider (1801).
E. croicensis,* Bl., pl. 221.
quinque-fasciatus, Benn. Ceylon, pl. 23, (fig. 60).
viridescens, Rüpp., ii, 7, fig. 2.
cæruleo-punctatus, Ib., 3.

Chlorurus, p. 227 = **Scarus** Forskæl (1775).
C. gibbus, Rüpp., Atl. pl. 20, fig. 2.

Sparisoma, p. 227 = **Scarus** Forskæl, subg. **Sparisoma**[2] Swainson.
S. Abildgardii,* Bloch, pl. 259.

Amphiscarus, p. 227 = ? **Teuthis** L. (1766).
A. fuscus,* Griff., Cuv., pl. 35.

Hemiulis, p. 228 = **Chilio** Lac. (1802).
H. vittatus, Griff., Cuv., pl. 6, 1.
guttatus, Bloch, pl. 357, 1.
auratus,* Frey, Atl. pl. 54, 2.
melapterus, Bloch, pl. 296, 2.

Cynædus,[3] p. 229 = **Cynædus** Sw. (1839).
C. Tinca,* Yarr., i, 293.
cornubicus, Ib., 296.
gibbus, Ib., 298.
luscus, Ib., 300.
rupestris, Bloch, pl. 250, fig. 1.
virens? Ib., 251, fig. 2.
notatus, Ib., 251, fig. 2.

[1] = *Pseudoscarus* Bleeker, 1861.

[2] = *Scarus* Bleeker.

[3] = *Crenilabrus* (not of Cuvier). Swainson observes: "M. Cuvier having expressly stated that the type of his genus *Crenilabrus* is the *Lutianus verres* of Bloch, I have so retained it, placing all the others, * * under the subgenus *Cynædus*." If this statement (which I am unable to verify) is correct, *Cynædus* Sw. must supersede *Crenilabrus*, which becomes a synonym of *Harpe*, Lac.

Astronotus,[1] p. 229 = **Astronotus** Sw. (1839).
A. ocellatus,* Spix, pl. 68.

Thalliurus,[2] p. 230 = **Thalliurus** Sw. (1839).
C. Blochii,* Bloch, pl. 260 (pl. ? 290).

Labristoma,[3] p. 230 = **Pseudochromis** Rüpp. (1835).
L. olivacea,* Rüpp., ii, pl. 2, fig. 3. flavivertex, ii, pl. 2, fig. 4.

Cichlasoma,[4] p. 230 = **Cichlasoma** Sw. (1839).
Labrus punctata,* Bloch, pl. 295, fig. 1.

Eupemis, p. 232 = **Chilio** Lac. (1802).
E. fusiformis,* Sw., Rüpp., Atl. ii, pl. 1, fig. 4.

Chlorichthys,[5] p. 232 = **Thalassoma** Sw. (1839).
bifasciatus,* Bl., pl. 283.
ornatus, Ib., pl. 280.
Braziliensis, Ib., pl. 280.
lunaris, Ib., pl. 281.
cæruleocephalus, Frey., Atl. pl. 56, fig. 2.
Grayii, Sw., Ind. Zool., ii, pl. 92, 1.
Hardwickii, Benn., pl. 12.
quadricolor, Less., Atl. pl. 32, 1.
semicæruleus, Rüpp., Atl. ii, pl. 3, fig. 1.
aygula, Rüpp., Atl. i, pl. 6, 2.

Icthycallus,[5] p. 232 = **Coris** Lac. (1800).
dimidiatus, Spix, pl. 58.
chloropterus, Bl., pl. 288.
trimaculatus, Griff., pl. 45, fig. 2.
decussatus, Benn., pl. 14.
auromaculatus, Ib., 20.
semidecorata, Less., Atl. pl. 35, fig. 2.
geoffroyii, Frey., Atl. pl. 56, fig. 3.
umbrostygma, Rüpp., Atl. ii, pl. 3, fig. 2.
semipunctatus,* Ib., pl. 3, fig. 3.
cyanocephalus, Ib., pl. 286.
julis, Ib., pl. 287, fig. 1.
bivittatus, Ib., pl. 284, fig. 1.
macrolepidatus, Ib., fig. 2.
ornatus, Linn., Tr. xii, pl. 27.

Zyphothyca, p. 239 = **Gempylus** Cuv. (1829).
Z. coluber * Sw. Cuv. and Val., pl. 221.

Zanclurus, p. 239 = **Histiophorus** Lac. (1802).
Z. indicus* Nob. Cuv. and Val., pl. 229. Bloch, 343.

Polycanthus, p. 242 = **Spinachia** Fleming (1828).
P. spinachia * Sw. Yarrell, i, 87. Bloch, pl. 53, fig. 1.

[1] = *Hygrogonus*, Günther, 1862.

[2] = *Hemigymnus*, Günther, 1862.

[3] "The name of *Pseudo*-chromis is so objectionable, that I hope the learned naturalist who proposed it, will excuse me for offering another." (*Swainson.*)

[4] = *Acara*, Heck, 1840 (in part).

[5] *Chlorichthys* and *Icthycallus*, confused jumbles of species, may well be disposed of as synonyms of *Thalassoma* and *Coris*, respectively, although several other genera are represented in each.

Leiurus, p. 242 = **Gasterosteus** L. (1758).
aculeatus.* Yarr. i, 81. brachycentrus. Yarr. i, 82.
spinulosus. Ib. i, 83. pungitius. Ib. i, 85.

Chirostoma, p. 243 = **Menidia** Bonaparte (1836), subg. **Chirostoma**[1] Sw. (1839).
A. Humboldtiana.* Cuv. and Val., pl. 306,* (fig. 67).

Meladerma, p. 243 = **Elacate** Cuv. (1829).
M. nigerrima.* Russ., pl. 153. (Pedda. mottah.).

Platylepes, p. 247 = **Lactarius** Cuv. (1833).
P. lactaria.* Cuv., pl. 261.

Argylepes, p. 247 = ?
A. Indica. Russ., pl. 156. (Mitta Parah.).

Trachinus,[2] p. 247 = **Trachurus** Raf. (1810).
Alepes, p. 248 = ?
A. melanoptera* Sw. Russel, pl. 155. (Evori Parah.).

Zonichthys, p. 248 = **Seriola** Cuv. (1829), subg. **Zonichthys** Sw. (1839).
Z. fasciatus.* Bloch, pl. 341.
subcarinata. Russ., pl. 149.

Hamiltonia, p. 250 = **Hamiltonia** Sw., 1839 (= **Bogoda** Bleck.).
H. ovata.* Sw. Ham., fig. 37.
lata. Sw. Ib., fig. 37.

Platysomus, p. 250 = **Caranx** Lac. (1802), subg. **Vomer** Cuv. (1817).
Brownii.* Cuv., pl. 256.
Micropteryx *Sw.* App.
Spixii *Sw.* Spix., pl. 57.

Ctenodon, p. 255 = **Acanthurus** Forsk. (1775).
C. Rüppelii* Sw. Rüpp. 16 (fig. 74).
rubropunctatus. Rüpp. 15, 1.
lineatus *Sw.* Benn., pl. 2.
Cuvierii. C. V., pl. 289.
erythromelas. Less. Atl. 27, 1.
fuliginosus. Lesson 27, 2.

Zebrasoma, p. 256 = **Acanthurus** Forsk. (1775).
velifer* Sw. Rüpp. Atlas, pl. 15, fig. 2. Bl., pl. 427.

Callicanthus, p. 256 = **Monoceros** Bl. & Schn. (1801).
C. elegans.* (Aspisurus elegans.) Rüpp. Atl. 16, fig. 2 (fig. 75).

Xiphichthys, p. 259 = **Trichiurus** L. (1766).
Z. Russelii* Sw. Russ. i, p. 40 (p. ? 41).

Xiphasia,[3] p. 259 = **Xiphasia** Sw.
Z. setifer* Sw. Russ., pl. 39.

[1] = *Heterognathus*, Girard, 1854.
[2] Evidently a misprint for *Trachurus*.
[3] = *Nemophis*, Kaup., 1858; = *Xiphogadus*, Günther, 1862.

Ornichthys, p. 262 = **Prionotus** Lac. (1802), subg. **Ornichthys** Sw. (1839).
Carolinensis (Carolinus). Bl. 352.
punctatus* Ib., pl. 353.

Macrochyrus, p. 264 = **Pterois** Cuv. (1817).
miles.* Benn. Ceyl., pl. 9.

Pteroleptus, p. 264 = **Pterois** Cuv. (1817).
P. longicauda.* Russ. ii, pl. 133.

Pteropterus, p. 264 = **Pterois** Cuv. (1817).
T. radiatus.* Cuv. and Val.

Brachyrus, p. 264 = **Pterois** Cuv. (1817).
zebra.* Cuv. iv, p. 367.
brachypterus, Ib. iv, p. 368.

Pterichthys, p. 265 = **Apistus** Cuv. (1829).
P. carinatus.* Cuv. iv., p. 395. Israelitorum Cuv., iv, p. 396.
alatus. Russ. No. 160, B.

Platypterus,[1] p. 265 = **Tetraroge** Günther. (1860).
tænianotus.* Cuv. Lac. iv., pl. 3, fig. 2. longispinis. Ib. iv, 408.
Bourgomvillii. Ib. iv, 411. fusco-virens. Ib. iv, 409.

Trichosomus,[2] p. 265, = **Prosopodasys** Cant. (1850).
trachinoides.* Cuv. pl. 92, 1.
dracæna. Cuv. iv. p. 403.

Gymnapistes,[3] p. 265 = **Gymnapistes** Sw. (1839).
marmoratus,* Griff. Cuv., pl. 22, fig. 3.
australis, White's Voy., pl. 52, fig. 1.
Belangerii Cuv., iv., p. 412.
barbatus, Ib, 413.
niger, Ib, 415.

Bufichthys,[4] p. 268 = **Synancia** Bl. & Schn. (1801).
horrida.* Lac. ii, pl. 17 2.
grossa. Gray. In. Zool., i, pl. 97.

Trachicephalus,[5] p. 268 = **Polycaulus** Günther. (1860).
elongatus* Griff. Cuv., pl. 8, f. 3.

[1] Preoccupied by several genera.

[2] Preoccupied by *Trichosoma* Rud. Verm., 1819.

[3] = *Pentaroge* Günther, 1860. (See Bleeker, Mem. Scorpen, 7, 1876). As founded by Swainson, *Gymnapistes* contains species of *Pentaroge*, *Centropogon*, *Tetraroge* and *Prosopadasys*, all genera posterior to Swainson. *Gymnapistes*, may therefore, be properly substituted for *Pentaroge*.

[4] = *Synancidium*, Müller, 1843.

[5] Preoccupied by *Trachycephalus* Tsch. 1838 (a genus of Reptiles).

Ichthyscopus, p. 269 = **Ichthyoscopus**[1] Sw. (1839.)
U. inermis.* Cuv. iii, pl. 65.
Fosteri, Ib. 318.
cirrhosus. Cuv., Ib. 314.
lævis. Ib. 319.

Enophrys, p. 271 = **Enophrys**[2] Sw. (1839).
E. claviger,* Cuv. and Val., pl. 79, fig. 2.

Gymnocanthus, p. 271 = **Gymnacanthus**[3] Sw. (1839).
G. ventralis.* Cuv. and Val., iv, pl. 79, fig. 1.

Hippocephalus,[4] p. 272 = **Hippocephalus** Sw. (1839).
superciliosus* Pall. Sp. Zool. vii, pl. 5.
decagonus Schn., pl. 27. quadricornus. Cuv. pl. 80.

Canthirynchus, p. 272 = **Aspidophoroides** Lac. (1802).
C. monopterygius,* Cuv. and Val., pl. 169.

Blenitrachus,[5] p. 274 = 0.

Erpiethys, p. 275 = **Salarias**, Cuv. (1817). subg.? **Erpiethys** Sw. (1839).
Atlanticus, Cuv., ix, 322.
quadripinnis,* Rüpp., 28, 2.
Sebæ, Ib., p. 323.
castaneus, Ib., 324.
fasciatus, Ib., 324.
cyclops, Ib., 32.
niger, Cuv., xi.
frontalis, Ib., 328.
ruficauda, Ib., 328.
quadricornis, Ib., 329.
variolatus? Ib., 346.
frænatus, Ib., 342.

Rupiscartes, p. 275 = **Salarias** Cuv. (1817).
R. alticus,* C. V. xi, 337.

Cirripectes, p. 275 = **Salarias** Cuv. (1817).
C. variolosus,* C. V., xi, 317.

Chirolophis, p. 275 = **Chirolophus**[6] Sw. (1839).
C. yarrellii,* C. V., xi, 218.

Clinetrachus, p. 276 = **Clinus** Cuv. (1817).
superciliosus,* Bl., pl 168. perspicillatus, C. V., xi, 372.

Blennophis, p. 276 = **Clinus**[7] Cuv. (1817), subg. **Blennophis** Sw. (1839).
anguillaris,* (Clinus, do. C. V., xi, 390).
variabilis, Raff. (1810). (Clinus argentatus, C. V., xi, 354.)

[1] = *Anema* Günther, 1860, as restricted by Gill, Proc. Ac. Nat. S Phila., 1861, 114.

[2] = *Aspicottus* Grd. (1854) = *Elaphocottus* Sauvage.

[3] = *Phobetor* Kröyer, 1844.

[4] Restricted by Gill, Proc. Ac. Nat. Sci., Phila., 1861, pp. 167, 259.

[5] No species mentioned, and apparently none known at the time.

[6] = *Blenniops* Nilsson, 1855; altered to *Carelophus* by Kröyer.

[7] Not *Blennophis* Val. of later date (about 1840) = *Ophioblennius*, G 1860.

Labrisomus, p. 277 = **Clinus** Cuv. (1817), subg. **Labrisomus** Sw. (1839).

L. gobio, C. V., xi, 395.
pectinifer,* Ib., 374.
capillatus, Ib., 377.
Delalandii, Ib., 378.
linearis, Ib., 371.
variolosus, Ib., 381.
Peruvianus, C. V., xi, 383.
microcirrhis, Ib., 384.
? geniguttatus, Ib., 86.
elegans, Ib., 388.
? littoreus, Ib., 389.
latipennis, Ib., 394.

Ophisomus,[1] p. 277 = **Murænoides** Lac. (1800).
O. gunnellus,* (Blennius gunnellus, Linn.), Yarrell, i, 239.

Ogrichodes, p. 278 = **Gebioides**, Lac. (1800).
G. Broussonetii,* Griff., Cuv., pl. 38, fig. 2.

Scartelaos, p. 279 = **Scartelaus**[2] Sw. (1839).
Sc. viridis.* Ham., pl. 32, fig. 12.
crysophthalmus. Ib., pl. 37, fig. 10.
calliurus. Ib., pl. 5, fig. 10.

Rupellia, p. 281 = **Gobius** L. (1758).
R. echinocephala.* Rüpp. Atl., i, pl. 34, fig. 3.

Amphichthys, p. 282 = **Batrachus** L. (1758).
rubigenes.* Sw. Appendix.

Salmophasia, p. 284 = **Chela** Buch. (1822).
oblonga. Sw. Ham., fig. 76. (Cyp. bacaila *).
elongata. Gray, Ind. Zool. (Cyp. cora.).

Chedrus, p. 285 = **Chedrus** Sw. (1839).
C. Grayii * Sw. Gray, Ind. Zool., pl. 2, f. 3.

Esomus, p. 285 = **Esomus** Sw. (= **Nuria** C. & V. ? 1842).
E. vittatus.* Sw. Ham., f. 88. (Daurua).

Clupisudis, p. 286 = **Clupisudis** Sw. (= **Heterotis** Ehrenberg, 1843).
C. niloticus.* Rüpp., Fish of the Nile, i, pl. 3, f. 2.

Laurida ("Aristotle"), p. 287 = **Synodus** Gronov. (1801).
L. Mediterranea *Sw.* (*Vol.* 1, *p.* 246, *fig.* 48).
fœtans.* Bl. 384, f. 2.
tumbel. Ib., 430.
truncata. Spix, pl. 45.
semifasciata. Bl. 384, f. 1.
conirostra. Spix, pl. 43.
intermedia. Ib., 44.
minuta Le Sueur. (Vol. 1, p. 247, *fig.* 50).

Triurus,[3] p. 288 = **Saurida** Val. (1849).
T. microcephalus.* Russell, pl. 171.

[1] = *Gunnellus* C. & V. (1817), rejected because of barbarous origin.

[2] = *Boleops* Gill (1863), *fide* Bleeker, Esq. Syst. Nat. Gobioides, 40, 1874.

[3] Preoccupied by *Triurus* Lacép. 1800.

Mormyrnynchus, p. 291 = **Schizodon** Agass. (1829).
M. Gronoveii * Sw. Gronov. Zooph., pl. 7, f. 2.

Trichosoma,[1] p. 292 = **Thrissa** Cuv. (1817).
Tr. Hamiltonii.* Gray, Ind. Zool., i, pl. 85, f. 3.

Setipinna, p. 292 = **Setipinna** Sw. (1839).
truncata Ham., p. 241, f. 72. megalura Sw., Ib., p. 240. (*Cl. phasa.**)

Platygaster,[2] p. 294 = **Pellona** Cuv. (1817).
Pl. Africanus.* Bl. 407.
megalopterus, Russ., pl. 191.
affinis, Gray, Ind. Zool.
parva, Gray, Ind. Zool., ii. pl. f. 3.
Indicus, Russ., pl. 192.

Cypsilurus, p. 296 = **Cypselurus** Sw. (1839).
C. Nuttalii * Le Sueur. Am. Tr. ii, pl. 4, fig. 1.
appendiculatus. Wood. Ib., iv, p. 283.

Leptodes, p. 298 = **Chauliodus** Bl. Schn. (1801).
L. sloanii.* Sch., pl. 85. L. Siculus. Sw. App.

Tilesia, p. 300 = **Gadus** L. (1758), subg. **Tilesia** Sw. (1839).
T. gracilis.* Til. Piscium, i, tab. 18.

Lepidion,[3] p. 300 = **Halopo.phyrus** Günther (1862).
L. rubescens * (Gadus lepidion Risso), xi, fig. 40, p. 118.

Cephus, p. 300 = **Gadus** Linn. (1758).
C. macrocephalus.* Til. Pisc., i, tab. 19.

Psetta,[4] p. 302 = **Bothus** Raf. (1810) subg. **Psetta** Sw.

[redacted]

Brachirus, p. 303 = **Euryglossa**[1] Kamp.
plagiusa, Linn.
orientalis,* Sch., 157.
zebra, Bloch, pl. 187.
Commersoni, Russ., No. 70.
jerreus, Russ., No. 71.
Pan, Hamil., pl. 14, fig. 42.

Hoplisoma, p. 304 = **Corydoras** Lac. (1803).
H. punctata,* Bloch, 377, fig. 2.

Sturisoma, p. 304 = **Loricaria** L. (1766), subg. **Sturisoma**, Sw.
S. rostrata,* Spix and Agassiz, pl. 3.

Felichthys,[2] p. 305 = **Felichthys** Sw. (1839).
F. filamentosus, Bl., pl. 365.
nodosus,* Bl. 368, fig. 1.

Cyclopium, p. 305 = **Cyclopium**[3] Sw. (1839).
C. humboldtii, Sw. (Pimelodus cyclopium,* *Auct.*)

Silonia[4] p. 305 = **Silondia** Sw. (1839).
S. lurida,* Ham., p. 160, 7, fig. 50.
diaphina, Ib., p. 162.

Pachypterus,[5] p. 306 = **Pseudeutropius** Blkr. (1863).
P. Atherinoides,* Bl. 371, f. 1.
luridus, Ham., p. 163, f. 62.
trifasciatus, Ib., p. 180, f. 59.
punctatus, Ham., p. 196, f. 64.
melanurus, Ib., (*Murius*, Ham), p. 195.

Clupisoma, p. 306 = **Clupisoma**[6] Sw. (1839).
C. argenata,* Ham., 156, pl. 21, fig. 50.

Pusichthys, p. 307 = **Schilbe** Cuv. (1817).
P. uranoscopus,* Rüpp., Egypt., pl. 1, fig. 1, *a*, *b*.

Cotylephorus, p. 308 = **Aspredo**[7] L. (1758).
C. Blochii,* Sw. (Platys. cotylephorus, Bl. 372).

Pteronotus, p. 309 = **Pimelodus** Lac. (1803).
P. 5-tentaculatus,* Sp. and Agassiz, pl. 11.

Acoura, p. 310 = **Nemachilus** Von Hasselt. (1823).
C. obscura,* Hamilt., p. 357. No. 9 (aberrant).
argentata, Ib., 358, No. 10.
cinerea, Ib., 359, No. 12.

[1] = *Euryglossa*, Kamp.; *plagiusa*, the first species mentioned, does not agree with the diagnosis, not having "*two* pectoral fins." *Brachirus* is preoccupied by *Brachyrus*, Swainson, both names being abridgments of *Brachychirus*.

[2] = *Auchenipterus*, Cuv. 1840.

[3] = *Stygogenes*, Gthr. (1864).

[4] Misprint for *Silondia* = (*Silundia*, C. & V., 1840).

[5] Preoccupied by *Pachypterus*, Sol., Col. 1833.

[6] = *Schilbeichthys*, Bleeker, 1858.

[7] = *Platystacus*, Bloch, 1801.

Canthophrys, p. 310 = **Botia** Gray (1831).
C. albescens,* Ham., Cob. No. 3. olivaceus, Ib., No. 8.
rubiginosus, Ib., No. 6. vittatus, Ib., No. 4 (aberr.).

Diacantha, p. 310 = **Botia** Gray (1831).
C. zebra,* Hamilt., pl. 11, f. 96. flavicauda, pl. 29, f. 95.

Somileptes, p. 311 = **Cobitis** L. (1758).
S. bispinosa,* Hamilt., p. 351. unispina, Ib., No. 1, p. 350.

Platysqualus, p. 318 = **Sphyrna** Raf. (1810).
S. tiburo,* Linn., Russ.,[1] pl. 12, fig. 2.

Pterocephala, p. 321 = **Dicerobatis** Blainville (1828).
P. Giorna,* Lac., v, pl. 20, 3.

Tetrosomus, p. 323 = **Ostracion** L. (1758).
T. turritus,* Bl., pl. 136.

Lactophrys, p. 324 = **Ostracion** L. (1758), subg. **Lactophrys** Sw. (1839).
L. trigonus,* Bl., pl. 35 (? 135). cornutus, Bl., 133.
bicaudalis, Ib., 132. quadricornus, Ib., 134.

Rhinesomus, p. 324 = **Ostracion** L. (1758).
R. triqueter,* Bloch, pl. 130. concatinatus, Ib., pl. 131.

Platycanthus, p. 324 = **Aracana** Gray (1838).
P. auratus,* Shaw, Nat. Miss., pl. 338.

Rhinecanthus, p. 325 = **Balistes** (1758).
ornatissimus,* Lesson, Atl., 10, 1. conspicullum, Ib., pl. 9, 1.
lineatus, Benn., Cey., pl. 10. amboynensis, In. Z., 8, 3.

Melichthys, p. 325 = **Balistes** L. (1758), subg. **Melichthys** Sw.

[redacted]

Psilocephalus,[1] p. 327 = **Psilocephalus** Sw. (1839).
P. barbatus,* Gray, Ind. Zool.

Cantherines, p. 327 = **Monacanthus** Cuv. (1817), subg. **Cantherines**[2] Sw. (1839).
C. nasutus,* Frey. Zool., p. 214.

Chætodermis, p. 327 = **Monacanthus** Cuv. (1817), subg. **Chætodermis** Sw.
C. spinosissimus,* Frey. Atl. pl. 45, fig. 3–8.
pennicilligerus, Cuv., Règ., An. pl. 12, fig. 3.

Trichoderma, p. 328 = **Monacanthus** Cuv. (1817), subg. **Amanses** Gray (1831–5).
T. scapus,* Lac. 1, pl. 18, f. 3. histrix, Sw., Gray, Ind. Zool.

Leisomus, p. 328 = **Tetrodon** L. (1758).
T. lævissimus,* Sch., marmoratus, Hamilt., pl. 18, fig. 3.

Lagocephalus, p. 328 = **Lagocephalus** Sw. (1839).
L. stellatus,* Bl., pl. 143. Pennantii, Yarrall, ii, 347 (? 457).

Cirrhisomus p. 328 = **Tetredon**[3] L. (1758).
C. Sprengleri,* Bloch, pl. 144.

Psilonotus, p. 328 = **Psilonotus**[4] Sw. (1839).
P. rostratus,* Bl. pl. 146. Electricus, Ph. Tr. 76, pl. 3.

Molacanthus, p. 329 = **Molacanthus** Sw. (1839).
M. Pallasii,* Sw. Pall. Spec. Zool. pl. 4.

Astrocanthus, p. 331 = **Halieutæa** Val. (1837).
A. stellatus,* Sw., Lac. i, pl. xi, figs. 2, 3.

Phyllopteryx, p. 332 = **Phyllopteryx** Sw. (1839).
P. foliatus,* Sw. (fig. 109).

Solegnathus, p. 333 = **Solonognathus** Sw. (1839).
S. hardwickii,* Gray, Ind. Zool., i, pl. 89, f. 3.

Ophisoma,[5] p. 334 = **Congromuræna** Kaup. (1856).
obtusa,* Sw., Appendix. acuta, Sw., App.

Leptognathus, p. 334 = **Ophichthys** Ahl. (1789), subg. **Leptognathus**.
L. oxyrhynchus,* Sw., app. (vol. 1, p. 221, fig. 42).

Pterurus,[6] p. 334 = **Moringua** Gray (1831).
P. maculatus,* Ham., p. 25. Triporosa, Russ. i, No. 34.
Hardwickii, Gray, Ind. Zool.

Pachyurus, p. 335 = **Moringua** Gray, (1831).
P. linearis,* Gray, Ind. Zool. i, pl. 95, fig. 3.

[1] = *Anacanthus* Gray, 1831, not of Ehrenberg, 1817.

[2] = *Liomonacanthus* Bleeker, 1866.

[3] = *Chilichthys* Müll., 1839.

[4] = *Anosmius* Ptrs., 1855.

[5] Preoccupied by *Ophisomus* Sw., p. 277.

[6] = *Rataboura* Gray, 1831–42.

Ophichthys,[1] p. 336 = **Amphipnous** Müll. (1839).
O. punctatus,* Ham., pl. 16, fig. 4 (*Cuchia*).

Rupisuga, p. 339 = **Lepadogaster** Gouan (1770).
L. nicensis,* Sw., Risso pl. 4, fig. 10 (? fig. 9).

In his "natural arrangement" or analytical key to the groups of Fishes, Swainson introduces several names of genera of which no examples are given and which do not occur further on in the body of the text. They are here given with their equivalence found in the text:—

1. **Cichlaurus,** p. 173 = **Cichlasoma** Sw.
2. **Pteropterus,** p. 180 = **Brachyrus** Sw.
3. **Gobileptes,** p. 183 (not in text).
4. **Psilosomus,** p. 183 = **Amblyopus** Cuv.
5. **Scrophicephalus,** p. 187 (not in text).
6. **Breviceps,** p. 189 = **Felichthys** Sw.
7. **Leiodon,** p. 194 = **Leisomus** Sw.
8. **Canthigaster,** p. 194 = **Psilonotus** Sw.

These names are, in my opinion, unworthy of attention, as in no case would it be possible to understand their author's meaning, were it not for the fuller description given in the text.

[1] Preoccupied by *Ophichthys*, Ahl. (1789).

Note on the Nest of Contopus virens.—Mr. THOMAS MEEHAN exhibited a nest of the "Wood Pewee," *Contopus virens*, built on a dead branch of a black-walnut tree on the grounds of Colonel Etting, of Delaware County, Pennsylvania, showing that it was fastened to the branch by spider's webs, and that the lichens with which the nest was so beautifully ornamented, were evidently attached to the nest in the same manner. There was no evidence of the employment of "viscid saliva" in building the nest, as contended by some ornithological writers.

Mr. Meehan remarked on the great beauty of the nest of this bird, in consequence of the employment of lichens in covering the outside, and observed that so far as human knowledge had yet penetrated, no physiological advantage resulted to this bird by the great trouble it took in this ornamentation, over other birds which were indifferent to such beauty; and we were left wholly, so far, to the conclusion that a love of beauty alone actuates the bird in the preparation of its work.

Note on an Abnormal Cabbage.—Mr. J. O. SCHIMMEL exhibited a plant of cabbage, which, instead of the usual head, made a stalk nearly three feet high, with a panicle of flowers at the top.

Mr. MEEHAN remarked that only on a smaller and weaker scale, this was the normal condition of the cabbage-plant, as he had collected it on the chalky cliffs of the sea-coasts of Europe. In nature the seeds matured in spring, and, falling to the ground, sprouted and made plants at once, which took the rest of the season to prepare for flowering the next spring. But the gardener saved the seed till late in the autumn or very early spring before sowing it, and this favored the vegetative rather than the reproductive system of the plant. In this case the longitudinal growth was arrested, and if we examine the regular cabbage-head, we find ten, fifteen, or often more leaves forming a single cycle round the stem, as in all cases of arrestation of growth—forming of a cone in the pine, for instance—the number of leaves in a cycle were increased. The formation of a head of cabbage was precisely after the method of nature in the making of a pine cone, and this was brought about simply by the change of season of sowing the seed, from that provided by nature. In the case of this specimen, nature had asserted her prerogative to do things in her own way, notwithstanding the change of season by man, though she did not get her way time enough to open the flowers and perfect seed. Here we found only five leaves to a cycle, and as we saw by the overlapping bases of the leaves, which formed the cabbage-stalk, the spiral arrangement was from left round to the right, or "with the sun."

Earthworms Drawing Leaves into the Ground.—Mr. POTTS exhibited a box of earth showing the action of the earthworm

drawing weeping-willow leaves into the earth. Most of them were drawn into the earth by the petioles, which being the easiest way, is referred to by Mr. Darwin in his work on the earthworm, as exhibiting intelligence in these humble creatures.

Mr. MEEHAN remarked that, though he had seen in England leaves drawn into the earth as described by Mr. Darwin, he had never seen a case in America, until those exhibited by Mr. Potts, though for many years he had had opportunities of observations enjoyed by few. The apparent rarity of this work of the earthworm in this country was worthy of consideration in connection with the objects of the creature in performing it.

Mr. POTTS stated that the ground beneath a willow tree in his garden was unusually well stocked with earthworms, many of them of large size. The damp weather of the last week or two had brought them to the surface at a time when the willow leaves, still green and succulent, were rapidly falling. These the worms collected during the night, drawing them down into their burrows, he thought, to an average depth of one inch per day or night.

The appearance of the neighborhood by daylight was very curious. Throughout the garden-beds, the grass-plot, the gravel-walk and even along the cracks of the brick pavement, wherever their burrows had reached the surface, the busy tenants had "planted" these leaves perpendicularly, sometimes singly, frequently in tufts of six, eight or more, giving the appearance of a child's play-garden or of the slip-boxes in a gardener's greenhouse.

On digging up the tufts, worms were generally found with an extremity near the base of the leaves; and here the latter seemed [redacted]

also a first true molar of the upper series, belonging to the left side of the jaw.

That this specimen is distinct from our black bear or *Ursus americanus*, there can be no doubt. Both the size and structure of the teeth distinctly forbid its reference to this species. The only differences, however, that he had been able to find between it and the typical grizzly bear, or *Ursus ferox*, consist in its smaller dimensions, and a slight exaggeration of the anterior basal lobe of the first true molar.

The geographical position of this specimen, together with this slight variation of structure, appear to have been important factors in establishing its claim to rank as a new and a distinct species.

With reference to the geographical position it may be said that there are many familiar examples of the various species of bears, enjoying a much wider geographical distribution than the existing grizzly bear or *Ursus ferox*. The black bear or *Ursus americanus* is well known to inhabit the extreme eastern and western portions of the North American continent, and ranges well to the north and the south. The polar bear or *Ursus maritimus*, inhabits almost, if not quite, the entire polar circle; and, indeed, Mr. G. Busk has in the Transactions Philos. Soc. of London, 1873, and later in Trans. Zoolog. Soc. London, for the year 1877, established the identity of *Ursus fossilis* of Goldfuss or *Ursus priscus*, Cuvier and Owen, with our existing grizzly bear or *Ursus ferox*.

In view of the fact, therefore, that the grizzly bear is now known to have inhabited Europe during Post Pliocene time, thereby greatly extending the boundaries of its present limits, little importance need be attached to a comparatively slight deviation from its present geographical range.

There is, probably, no family among the mammalia which is subject to greater variation, in size and structure, than the *Ursidæ*. The grizzly bears inhabiting the mountains of California and Oregon, are larger and more robust than those living upon the eastern slope of the Rocky Mountains. So far, indeed, is this true, that some authors have made two distinct species of them. The bear of the Rocky Mountain region is familiarly known to hunters as the "silver-tip bear," and is said to display even more pugnacity of character than the true California grizzly.

The small size of the individual under consideration is in keeping with what we should reasonably expect to find at a point considerably to the east of the present boundary of the range of this species.

The measurements of the crown of the last lower molar, are as follows: Antero-posterior diameter, ·75 inch; transverse diameter, ·60 inch. The crown of the first upper molar measures in the antero-posterior diameter ·82 inch, while in the transverse diameter it is ·64 inch.

The average dimensions of the corresponding tooth of *Ursus*

ferox, as given by Mr. Busk in Trans. Philos. Soc, 1873, p. 542, are ·92 by ·62 inch in the transverse, with a minimum dimension of ·85 by ·55 inch.

The experience of the speaker upon examination of quite a number of skulls of this species, had been to reduce the minimum dimension, recorded by Mr. Busk, which would affect the general average.

In one young but well marked specimen of *Ursus ferox*, in the collection of the Academy, the dimensions of the crown of the last lower molar are ·77 by ·62 inch. In another fully adult individual, bearing all the characteristics of the species, the measurements of this tooth are ·75 by ·57 inch. The dimensions of the first superior molar in this specimen are the same as those in the fossil specimen under consideration. It will be observed, therefore, that *Ursus amplidens* is intermediate in size between these two well defined specimens of *Ursus ferox*.

There is no character left by which we can distinguish this species, but the slight exaggeration of the anterior basal lobe of the superior molar, which is so very variable as to be almost worthless for this purpose.

Ursus amplidens is, therefore, but a variety at best, if not identical with the smaller varieties of *Ursus ferox*.

NOVEMBER 28.

The President, Dr. LEIDY, in the chair.

Forty-one persons present.

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minute crystals of red-brown siderite and the latter passes into limonite. With these one sees sheaf-like aggregations of a zeolite, which from the form of single crystals appears to be Thompsonite. Some of these crystals are beautifully transparent, with tetragonal habitus—two opposite prismatic faces are striated longitudinally (pinakoïd), basis and macrodome are found on all individuals. The crystals are, however, very small and cannot be measured satisfactorily. Analyses have not been made. The determinations are not, therefore, absolute, except in the case of chabazite. The resemblance of this occurrence to that of Baltimore is very striking. Thompsonite is new for Pennsylvania, chabazite and stilbite for Leiperville, in the speaker's knowledge.

Chapter V, Article 4, of the By-Laws, was amended by adding the following:—But Sections may admit persons not members of the Academy to be Contributors under such rules and on such terms as the Section may determine, always provided, that a Contributor shall not be eligible to office in a Section, or to vote on any question; and also provided, that the rights and privileges of a Contributor shall be restricted to attendance at the meetings of the Section, to the reading of original scientific papers, and to taking part in scientific discussions and proceedings exclusively, and that a Contributor shall have no other right or privilege whatever in the Academy.

F. Lynwood Garrison and Mrs. H. Carvill Lewis, were elected members.

DECEMBER 5.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Twenty-five persons present.

A paper, entitled "On Uintatherium, Bathmodon and Triïsodon," by Edw. D. Cope, was presented for publication.

DECEMBER 12.

The President, Dr. LEIDY, in the chair.

Forty-five persons present.

The following papers were presented for publication:—

"An Identification of the Species of Fishes described in Shaw's General Zoology," by Jos. Swain.

"On the Value of the Nearctic as one of the Primary Zoological Regions," by Angelo Heilprin.

On Remains of Horses.—Prof. LEIDY directed attention to some specimens, which were recently sent to him for examination by the Secretary of the Smithsonian Institution. He remarked that it was commonly believed that the horse was not living in America when this was discovered by Europeans, but there is abundance of evidence to prove the former existence in this country of many species and genera of closely related forms. Among the remains of these some are undistinguishable in anatomical characters and size from the corresponding parts of the domestic horse. As this during the past four centuries has become widely and abundantly distributed over both continents, its remains have become buried everywhere, and often in the older deposits, where they are mingled with the fossils pertaining to the latter. Under these circumstances it is commonly difficult and frequently impossible to determine whether specimens submitted to us for examination are to be regarded as true fossils or comparatively recent remains. Such is the character of the specimens now exhibited.

Several consist of fragments (No. 16537-8) of the left ramus of the mandible of a horse. They were obtained at Aspinwall, Panama, by Capt. J. M. Dow; but no reference is made to the nature of the deposit in which they were found. They are well preserved, firm in texture, without fissures, and stained brown from ferruginous infiltration. One of the fragments contains the molar series nearly perfect except the first and last. They are more than half worn away and agree closely with those of the domestic horse in the same condition.

[redacted]

tarsal, exhibiting on each side behind the articular impressions of the smaller metatarsals. The articular end measures 13 lines transversely and 11 lines fore and aft. The other fragment is the proximal articular end of a first phalanx, measuring 14 lines transversely and 8 lines fore and aft. Of the teeth two are lower molars, apparently of different individuals. One, a fourth or fifth of the series, is little worn, but has lost its exterior cementum. It is about 2 inches long and at the triturating surface measures 9 lines fore and aft and 4½ lines transversely. The other lower molar, probably the third of the series, is about half worn, but is broken away below, and yet retains its outer cementum. It measures 9 lines fore and aft and 5 lines transversely. The remaining tooth, the most characteristic of the specimens, is an upper molar, apparently the fourth of the series of the right side. It is but little worn, is well preserved and retains its exterior cementum. It measures about 2 inches long and at the triturating surface is 9½ lines fore and aft and 9 lines transversely.

The specimens indicate a species about the size of *Hippotherium venustum* and *H. speciosum*, but the folding of the enamel on the triturating surface of the upper molar, as represented in the accompanying figure, is sufficiently different from the arrangement in the corresponding teeth of those species, to render it probable that the fossils belong to neither of them.

In *H. venustum* the inner column of the superior molars, so far as known, is regularly cylindrical; in *H. speciosum* it is compressed cylindrical. In the tooth under inspection it is much wider than in the latter. The fossils probably indicated an undescribed species, and for this the name *Hippotherium montezuma* was suggested.

Prof. COPE remarked that he believed that the contemporaneity of man with the horse and other extinct pliocene mammals in Western North America would soon be satisfactorily demonstrated. The first evidence on the subject was furnished by J. D. Whitney, Chief of the Geological Survey of California, in the case of the Calaveras skull, which was said to be taken from the gold-bearing gravel; and in several other cases subsequently added. From the fact that scientific observers were never present at the unearthing of the remains of man and his works from this formation, the evidence has been generally regarded as inconclusive. The gold-bearing gravel of California is, however, a very peculiar formation, and an object buried in it would carry such marks of its origin as to be quite recognizable. This was the case with the Calaveras skull when first discovered, as I am informed by Prof. Verrill of Yale College. This gentleman states that the skull, when found, was partially filled and covered with the hard adhesive "cement" so characteristic of the formation.

Prof. Cope referred to two observations of his own made in

1879 in Oregon [1] and California,[2] which were confirmatory of the existence of man in the upper pliocene of both those States, but the evidence was in neither case absolutely conclusive.

The discovery that the tracks of several species of pliocene mammalia [3] in the argillaceous sandstones of the quarry of the Nevada State Prison at Carson, are accompanied by those of a biped resembling man, is a further confirmation of these views. The tracks are clearly those of a biped, and are not those of a member of the *Simiidæ*, but must be referred to the *Hominidæ*. Whether they belong to a species of the genus *Homo* or not, cannot be ascertained from the tracks alone, but can be determined on the discovery of the bones and teeth. In any case the animal was probably the ancestor of existing man, and was a contemporary of the *Elephas primigenius* and a species of *Equus*.

Professor LEWIS drew attention to the caution that should be taken in accepting as evidences of pliocene man any facts as yet not verified by scientific observers. While the facts proving a post-glacial man are indisputable, the existence of pre-glacial man, either in our own country or in Europe, is not attested by satisfactory evidence. The discoveries in California, just referred to, made for the most part by miners in their search for gold, carry with them several serious objections to the great antiquity assigned to the relics thus found.

In the first place, the characters of the implements are identical with those of modern workmanship, while the Calaveras skull closely resembles that of a modern Indian. The implements, consisting of large granite mortars, polished spearheads of obsidian, gaming disks, finely marked pendants of greenstone and syenite, hammers, pestles, arrowheads, beads, etc., are of quite as perfect [redacted]

in quite recent times. It is unnecessary here, in support of this fact, to more than mention the modern coins and other objects so frequently found in a compact gravel firmly cemented.

Again, there is no sufficient evidence that the gravel in which many of these relics were reported to have been found was undisturbed. Most of the implements were found on the banks of streams, some of them in the bottom of river-beds, in both of which places landslips may have occurred, while the few found in shafts have never been satisfactorily demonstrated to lie in a position which could not have been disturbed.

The very fact that these relics all occur in a gold-bearing gravel may indicate the method by which many of them were buried. That gold-mining was carried on in these same gravels by the aborigines upon an extensive scale is well attested. Schoolcraft describes an ancient shaft which penetrated Table Mountain to a depth of 210 feet, at the bottom of which were human bones and implements. This is the very locality where a number of implements and a skull of supposed pliocene man were afterwards found. Other authorities might be quoted to show the numerous mining operations of the aborigines. The mortars already described were probably used in the process of extracting gold from the gravel.

Another point of importance is the fact that the earliest relics of man, either in the river gravels of Europe and Great Britain, or in those of the Delaware, are of an ancient type, unlike those of more recent times. These *palæolithic* implements, with the associated bones of animals now extinct, are the most certain evidences of primeval man, and belong to the age immediately following the glacial epoch. It is not, therefore, probable that the highly fashioned implements of California, having the most neolithic type, belong to a race of pre-glacial men anterior to those of the river gravels of Europe. The argument from analogy is so strong against the great antiquity of the Californian relics, that evidence of the most satisfactory kind must be required to support such a conclusion.

The following was ordered to be published:—

ON UINTATHERIUM, BATHMODON AND TRIISODON.

BY E. D. COPE.

Bathmodon pachypus Cope, sp. nov.

The species originally described by me under the name of *Bathmodon radians*, was based on a number of specimens obtained by Dr. Hayden, from the Wasatch formation near Evanston, Wyoming. I subsequently ascertained that this material included two species, a larger and a smaller. The latter I described under the name of *Bathmodon latipes*[1]: for the larger the name of *Bathmodon radians* was retained. Besides various diversities between the skeletons of these species, their astragali exhibit characters which indicate that the genus *Bathmodon* is distinct from *Coryphodon*, although I have admitted their supposed identity in some of my publications.[2] I pointed out the differential characters of the two genera in 1882,[3] but did not then express the most important feature. I then defined *Bathmodon* as follows: "Astragalus subquadrate, without internal hook," and *Coryphodon*, "Astragalus transverse, with internal hook." The absence of the internal prolongation of the astragalus in *Bathmodon*, is due to the presence of a facet for articulation with some bone, which is not found in *Coryphodon*. This may have been a proximal

[redacted]

		M.
Length of humerus,		·400
Diameters of proximal extremity	anteroposterior,	·107
	transverse oblique,	·159
Width at epicondyles,		·166
Diameters of condyles	transverse,	·112
	anteroposterior, roller,	·058
	anteroposterior, flange,	·087
Length of pelvis antero-posteriorly,		·600
Chord of crest of ilium,		·350
Anteroposterior width of peduncle ilium,		·110
Length of ischium from acetabulum,		·150
Length of pubis to symphysis do.,		·160
Length of femur,		·527
Width of femur proximately,		·160
Diameter of head of femur,		·080
Diameter of shaft above third trochanter,		·066
Diameter of shaft at third trochanter,		·106
Width of condyles of femur,		·134
Depth of condyles with rotular crest,		·126
Diameters of astragalus above	anteroposterior,	·0675
	transverse,	·0800
Length of calcaneum,		·100

From the Wasatch of the Big Horn, J. L. Wortman.

Uintatherium robustum Leidy.

I have for some years had in my possession a fragmentary lower jaw from the Bridger beds of Wyoming, which I have been unable to refer to its proper place in the system. It is described in part in the Annual Report of the U. S. Geological Survey of the Territories, 1872, p. 565. The rami support roots and crowns of six molars, and the symphysis has two alveoli on each side. The peculiarity of the animal consists in this latter fact, since the species so far as described, are said to have four teeth on each side of the symphysis, viz., three incisors and one canine. Those present in the present species I suppose to be incisors. The molar teeth are so much like those of *Uintatherium robustum*, that I believe the specimen to belong to that species.

Symphysis very much compressed, so that the incisor teeth of opposite sides are close together; its inferior outline curved

upwards to the alveolar edge, in an obtuse keel. Base of flange for superior canine distinct, commencing below the posterior edge of the posterior alveolus, and immediately preceded by a mental foramen. Middle line of symphysis rugose. Ramus at last molar robust, owing to the prominence of the inferior part of the anterior masseteric ridge. In connection with the oblique position of the head, the inferior molars are oblique to the long axis of the ramus, sloping upwards and backwards, with exposed anterior roots. The molars increase in size posteriorly, and the last one is abruptly larger than the penultimate. Their structure is as in *U. robustum*, *i. e.*, with an obliquely transverse high crest in front, and a low posterior transverse edge of the heel, and a short oblique crest between the two. The last named is short, and is directed obliquely outwards and forwards towards the external extremity of the anterior crest, but disappears before reaching it. The internal extremity of this and of the low posterior crest, with the external extremity of the anterior crest, rise into cusps. At the middle of the anterior base of the anterior transverse crest there is a tubercle, which represents the anterior limb of the anterior V in *Coryphodon*. The crowns of the premolars are broken away in the specimen.

The alveoli of the incisors are flat, and are directed forwards at an angle of only 20° from the horizontal until near their orifices, where the angle is greater. The roots of the incisors are thus [redacted]

Although the crowns are somewhat worn, the enamel is wrinkled intermediately between coarse and fine.

The specimen described was obtained in the Bridger beds on Henry's Fork of Green River, Wyoming.

Triisodon conidens Cope.

A right maxillary bone and corresponding mandibular ramus represent this species in my collection. The former sustains the last five molars, and the latter the last three, with alveoli of the others and of the canine tooth. The pieces indicate a skull of the size of that of the wolf, and a good deal more robust in its vertical measurements.

The third superior premolar has a base of triangular outline, the external side longer than either of the internal, which are connected by a broadly rounded angle. The external cusp is of lenticular section at the base, and circular section near the apex. An internal cusp is represented by a strong cingulum as in *Periptychus*, which connects with the posterior base of the external cusp. The crown of the fourth superior premolar has a triangular base of which the anterior side is shorter than either of the other two, which are subequal. The external cusp is large, simple, and subconic. The internal is distinct but smaller and is continued posteriorly as a cingulum to the posterior base of the external cusp. No internal cingulum. The crown of the first true molar is worn to the roots. The second true molar is the longest of the series. Its base is a triangle, placed transversely to the axis of the jaw, of which the external side is the shortest, the anterior the next longer, and the posterior the longest. The apex or internal extremity of the crown is obtusely rounded. There are two subequal external cusps, which are injured in the specimen. The internal cusp is the apex of a V whose limbs form the anterior and posterior edges of the grinding face of the crown, extending outwards to near the bases of the external cusps. Posterior to the posterior one is a strong basal cingulum. No internal, and a faint anterior cingulum. There is probably an external cingulum, but it is broken away. The last molar is of an oval outline placed transversely to the cranial axis, both the external and internal extremities contracted, the latter a little the more so. There is a large anterior external conical cusp. The posterior external is small, and is situated at the posterior third of the posterior border of the

crown. The internal cusp is well developed, and has a subcircular section. There are strong external and posterior cingula, and a weak anterior one, but no internal cingulum. The posterior extremity of the maxillary bone within the zygoma, is immediately above the posterior border of the last superior molar.

Measurements of Superior Molars.		M.
Length of bases of posterior five,		·069
Diameters base, Pm. iii,	anteroposterior,	·013
	transverse,	·009
Diameters base, Pm. iv,	anteroposterior,	·0145
	transverse,	·014
Length base of true molars,		·039
Diameters base of m. ii,	anteroposterior,	·0175
	transverse,	·021
Diameters base, m. iii,	anteroposterior,	·010
	transverse,	·0175
Elevation of base of zygoma, above base of m. iii,		·018

The ramus of the lower jaw is, as usually with the Creodonta, deeper and less robust than that of Carnivora of corresponding size. It is also more compressed than that of the *Triïsodon quivirensis.* It retains its depth to below the canine teeth, and does not shallow below the middle of the coronoid process, where also there is no tendency to inflection. The anterior masseteric [redacted]

ridge forwards towards the base of the anterior cone of the tooth. The external is the larger, and reaches that base. The internal is smaller, and falls short of it. The posterior inferior molar differs from the others in form as well as in size. There is no posterior inner anterior cusp, the large external cusp being supplemented by a small anterior internal only, which sends a little ridge downwards and posteriorly. The heel is narrowed, and supports the two cusps on its posterior border in contact, and not separate as on the other teeth. The external is the larger, and extends forwards to the base of the anterior cone near its middle. Some remnants of hard matrix leave it uncertain whether there is a small median posterior marginal tubercle on the first and second molars or not.

The first inferior true molar has a strong external cingulum; the second has none; the third has one, which is most evident between the cusps, is weaker at the base of the posterior lobe, and faint at the anterior lobe. No internal cingula.

Measurements.		M.
Length of true molar series,		·052
Length from m. iii to anterior masseteric ridge,		·013
Diameters of m. i,	anteroposterior,	·017
	transverse,	·0115
Diameters of m. ii,	anteroposterior,	·018
	transverse,	·011
Diameters of m. iii,	anteroposterior,	·016
	transverse,	·0105
Depth of ramus at m. iii,		·047
Width of ramus at m. iii, inferiorly,		·013

The molar teeth of this species are more like those of the *T. heilprinianus* than those of the *T. quivirensis.* This is seen in the more conic character of the anterior lobe of the tooth, and the better development of the anterior inner cusp. The species is a good deal larger than the *T. quivirensis.*

From the Puerco beds of N. W. New Mexico, D. Baldwin.

NOTE.—The superior molar teeth show a resemblance to those of *Mesonyx*, and also to those of *Deltatherium.* Among the *Mesonychidæ*, *Triisodon* approaches *Sarcothraustes* in the form of the inferior molars, in the expanded heel. On the other hand, the

appearance of the anterior cusp of the inferior molars approa what is seen in *Amblyctonus*. The small transverse poste superior molar of *Triisodon* further distinguishes it from *Aml tonus*. A series of modifications of the dental characters procee from the simple to the more complex, may be constructed as foll 1. *Mesonyx*; 2. *Dissacus*; 3. *Sarcothraustes*; 4. *Triisodon Amblyctonus*; 6. *Deltatherium*. The first three belong to *Mesonychidæ*, as distinguished by the form of the tarsal ar lations. Whether *Triisodon* must be arranged with *Amblyct* or not, cannot be ascertained until the foot structure is know

DECEMBER 19.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

The deaths of Jos. S. Lovering, Jr., and Dr. John Forsyth Meigs, members, were announced.

On an extinct Peccary.—Prof. LEIDY said he regarded it as remarkable, that among the mulitude of remains of extinct mammals found in this country, many of which were of genera common to the old world, no well authenticated remains of Hippopotamus and of the Hog had been discovered. The representative of the latter in this country is the Peccary, of which there are two known living species, pertaining to South America, with one of them extending into Mexico and Texas. The remains of a number of extinct species have been found in the United States and territories, partly referable to *Dicotyles*, and others to a nearly allied genus, described by Dr. Le Conte under the name of *Platygonus*. In this the constituent lobes of the molar teeth are conspicuously prominent, comparatively smooth, and approximate in form those of ruminants. In *Dicotyles* they are comparatively low, wrinkled, and approximate more those of the hog.

Several fossil specimens exhibited, probably indicate an undescribed species of *Platygonus*, larger and of more robust proportions than the *P. compressus*. They have been submitted for examination by Mr. Wm. B. Henderson, who reports that they were found in clay and gravel, in a limestone quarry, in Mifflin Co., Pa. They consist of two jaw fragments with teeth, the bone being encrustated with a hard ferruginous cement of limestone and gravel. The lower jaw fragment contains the greater part of the last two molars. The jaw below the position of the first molar is thick and shallow; below the last tooth it abruptly deepens, and a short distance back is nearly double the depth. The upper jaw fragment contains the greater part of the molars and last premolar. The upper teeth exhibit a well produced basal ridge fore and aft, but none laterally, except the feeble elements of it between the lobes of the crowns.

Comparative measurements of the two fossil specimens with corresponding parts in the skull of *P. compressus* are as follows:

	P. vetus.	P. compressus.
Depth of lower jaw below first molar,	42 mm.	37 mm.
Thickness of lower jaw below first molar,	22 "	17 "
Depth of lower jaw back of last molar,	78 "	45 "
Space occupied by the last two molars,	47 "	38 "

	P. vetus.	P. compressus.
Fore and aft diameter of second molar,	21 mm.	17 mm.
Transverse diameter of second molar,	15 "	11 "
Fore and aft diameter of last molar,	28 "	21 "
Transverse diameter of last molar,	16 "	13 "
Breadth of face outside last premolars,	56 "	45 "
Breadth of face outside last molars,	68 "	52 "
Space occupied by upper molars,	62 "	50 "
Fore and aft diameter of first molar,	17 "	13 "
Transverse diameter of first molar,	16 "	12 "
Fore and aft diameter of second molar,	20 "	17 "
Transverse diameter of second molar,	18 "	14 "
Fore and aft diameter of last molar,	24 "	21 "
Transverse diameter of last molar,	19 "	14 "
Fore and aft diameter of last premolar,	12 "	11 "
Transverse diameter of last premolar,	15 "	11 "

The species may be named PLATYGONUS VETUS, though it is by no means certain that it does not pertain to one of the forms described by Prof. Marsh, from the western territories.

The following was ordered to be printed:—

AN IDENTIFICATION OF THE SPECIES OF FISHES DESCRIBED IN SHAW'S GENERAL ZOOLOGY.

BY JOSEPH SWAIN.

In the early part of the present century, Dr. George Shaw compiled a "General Zoölogy" or "Systematic Natural History," which was to contain descriptions of all the animals then known. In the two volumes on fishes,[1] he introduced a large number of new specific names, most of them arbitrary, and unwarranted alterations of prior names, the rest chiefly for species described by travelers, which had been for one reason or another left without binomial designation. Of all the various compilations of the kind, pertaining to fishes, this work of Shaw's is probably the least worthy. Some of the names, however, have priority of date. I here give a list of all the new generic and specific names introduced by Shaw, with the name which the form in question should bear, so far as I can ascertain it.

Cases involving difficulty of identification or doubt as to proper nomenclature, have been referred to Prof. Jordan, to whom I am also indebted for numerous suggestions, and for the use of his library.

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NAME.	PAGE.	IDENTIFICATION.
Anguilla vulgaris, . pl. 1,	15	Anguilla vulgaris,[2] Shaw.
Muræna romana, . . .	26	Muræna helena, L.
Muræna africana, . . .	30	Sidera afra (Bloch), Swain.
Muræna meleagris, . . .	32	Sidera meleagris (Shaw), Swain.
Muræna[3] viridis, . . .	33	? Ophichthys, sp.
Monopterus javanicus, . .	39	Monopterus javenensis, La Cépède.
Odontognathus abdomine aculeata, . . . pl. 8,	74	Odontognathus mucronatus, La Cépède.
Triurus[4] commersonii, . .	78	?
Genus Stylephorus, . . .	87	Genus Stylephorus.

[1] General Zoology of Systematic Natural History, by George Shaw, M. D., F. R. S., etc., with plates from the first authorities and most select specimens. Engraved principally by Mr. Heath, London (vol. iv, 1803; vol. v, 1804).

[2] Prior to *Anguilla vulgaris* Turton (1806), and Rafinesque (1810).

[3] *Muræna viridis* is based on "*Serpens Marinus americanus*, Seb. 3, t. 70, f. 2," apparently not identifiable.

[4] Based on *Triurus bougainvillianus* La Cépède, ii, 201.

NAME	PAGE.	IDENTIFICATION.
Stylephorus cordatus,	pl. 11, 87	Stylephorus cordatus, Shaw.
Xiphias platypterus,	pl. 15, 101	Xiphias gladius, Linnæus.
Xiphias makaira, .	pl. 16, 104	Histiophorus gladius (Brouss.) La C.
Gadus[1] leverianus,	. . 153	?
Blennius trifurcatus,	. . 174	Raniceps trifurcus (Walb.), Cuv.
Cepola hermanniana,	. . 191	Tænioides hermannii,[2] La Cépède
Gymnetrus ascanii,	pl. 27, 193	Regalecus glesne, Ascan.
Genus Vandellius, .	. . 199	Lepidopus (Gouan), Bl. & Schn.
Gobius ater, . .	. . 243	Gobius ater,[3] Shaw.
Gobiomorus australis,	. . 249	Eleotris strigata (Brouss.), C. & V.
Cottus[4] australis, .	. . 263	?
Scorpæna commersonii, .	. 271	Pterois volitans (L.), C. & V.
Scorpæna bicapillata,	pl. 40, 273	Synancia bicirrata (La C.), Swain
Scorpæna brachiata,	. . 274	Synancia verrucosa, Bloch.
Zeus opah, . .	pl. 42, 287	Lampris guttatus (Brünnich) Retzius.
Pleuronectes roseus,	pl. 43, 302	Pleuronectes flesus, L.
Pleuronectes rondeletii, .	. 307	Solea ocellata (L.), Günther.
Pleuronectes[5] argenteus, .	. 308	?
Pleuronectes diaphanus, .	. 309	Arnoglossus laterna (Walb.) Gün
Pleuronectes tuberculatus,	. 312	Psetta maxima (L.), Swainson.
Chætodon imperialis,	pl. 41, 324	Holacanthus imperator (Bloch.) La C.
Chætodon bifasciatus,	. . 342	Heniochus macrolepidotus (L.) C. & V.
Chætodon plectorhynchus,	pl. 49, 356	Plectorhynchus chætodontöides La C.
Acanthurus nasus,	pl. 51, 376	Monoceros tuberosus (LaC.), Swain
Acanthurus[6] militaris,	. . 380	Acanthurus, sp.
Acanthurus harpurus,	. . 381	Monoceros lituratus (Forst.) Swain
Acanthurus achilles,	. . 383	Acanthurus achilles, Shaw.
Acanthurus[7] umbratus, .	. 384	?

[1] Described from a specimen in the Leverian Museum, which is "supposed" to be a native of the Southern Ocean, being placed in a collection of fishes taken during the last voyage of Captain Cook.

[2] Not *hermannianus*, as usually quoted.

[3] *Gobius ater* Shaw, is based on *Gobius niger* La C. (not of Linnæus). If this is a valid species, it seems to have been overlooked by other writers.

[4] *Cottus australis* Shaw, is "a doubtful species; described by myself in Mr. White's Voyage to Botany Bay" (Shaw).

[5] *Pleuronectes argenteus* is based on a partial description by Petiver, in "Gazoph. 10, t. 26."

[6] "Native of the Indian and American seas. In the British and Leverian Museums." (Shaw.)

[7] "Native of the Indian seas. In the British Museum." (Shaw.)

NAME.	PAGE.	IDENTIFICATION.
Acanthurus[1] meleagris, . .	385	?
Trichopus arabicus, . .	390	Thalassoma lunare (L.), Swain.
Trichopus satyrus, . .	391	Osphromenus goramy, La Cépède.
Trichopus pallasii, . .	392	Osphromenus trichopterus (Pall.), Günther.
Trichopus monodactylus, .	392	Monodactylus falciformis, La Cépède.
Scarus purpuratus, . .	397	Thalassoma purpuream (Forsk.), Swainson.
Scarus[2] rostratus, . . .	401	?
Sparus[3] bicinctus, . . .	418	?
Sparus brunnichii, . .	424	Sparus bogaraveo, Brünn.
Sparus commersonii, . .	428	Gerres oyena (Forsk.), Cuv. & Val.
Sparus melanotus, . . .	431	Lutjanus argentimaculatus (Forsk.), Swain.
Sparus luna, ...	433	Lutjanus chrysurus (Bloch), Vaill.
Sparus serran, . . .	439	Serranus cabrilla (L.), Risso.
Sparus[4] sciurus, . pl. 64.	439	Serranus formosus (L.), J. & G.
Sparus argyropthalmus,	441	Priacanthus[5] macrophthalmus (Bloch), Swain.
Sparus[6] reticulatus, . .	447	?
Sparus zonatus, . . .	452	Thalliurus fasciatus (Thun.), Swn.
Sparus hemisphæricus, pl. 66,	554	Xyrichthys fuscus (La C.), Swain.
Sparus brachiatus, pl. 66,	456	Xyrichthys fuscus (La C.), Swain.
Sparus magnificus, . .	463	Conodon nobilis (L.), J. & G.
Sparus[7] palpebratus, . .	464	?
Sparus tranquebaricus, . .	471	Lutjanus johnii (Bloch), Vaill.
Sparus semifasciatus, . .	472	Epinephelus striatus (Bloch), Gill.
Sparus[8] trilineatus, . .	472	?
Sparus[9] cepedianus, . .	473	? Lutjanus, sp.

[1] "Native of the Indian and American seas. In the British Museum." (Shaw.)

[2] "Slightly described by Cépède from the MSS. of Commerson." (Shaw.)

[3] Based on "Sp. *bivittatus* Bloch, t. 263."

[4] *Sparus sciurus* Shaw, includes *Diabasis elegans* (C. & V.) J. & G. and *Serranus formosus* (L.) J. & G. *S. sciurus* may be considered as a synonym of *S. formosus*.

[5] Not *P. macrophthalmus* Cuv. and Val. = *P. arenatus* C. & V.

[6] Based on *Sparus capistratus* Gmelin.

[7] Based on *Perca palpebrosa* L.

[8] Based on *Anthias lineatus* Bloch, t. 326, f. 1.

[9] Based on *Lutjanus albo-aureus* La Cépède, iv, 239.

NAME.	PAGE.	IDENTIFICATION.
Sparus[1] sigillatus, . . .	474	?
Gomphosus variegatus, pl. 69,	480	Gomphosus varius, La Cépède.
Labrus albidus, . . .	490	Percis tetracanthus (La C.), Swain.
Labrus undulatus, . . .	496	Julis lunaris (L.), Cuv. & Val.
Labrus ballanus, . pl. 71,	498	Labrus bergylta, Ascanius.
Labrus ascanii, . . .	512	Cynædus melops (L.), Swain.
Labrus[2] carinatus, . . .	522	?
Labrus[3] cupreus, . . .	527	?
Sciæna gibbosa, . . .	539	Lutjanus gibbus, Bloch.
Holocentrus decussatus, .	557	Epinephelus[4] decussatus (Shaw), Swain.
Holocentrus japonicus, . .	565	Epinephelus[5] ruber, Bloch.
Holocentrus testudineus, .	566	Epinephelus brunneus, Bloch.
Holocentrus marginatus, .	566	Epinephelus marginalis, Bloch.
Holocentrus bicolor, . .	568	Epinephelus albofuscus (La C.), Swain.
Bodianus zebra, . . .	574	Bodianus bœnack, Bloch.
Bodianus lunulatus, . .	575	Bodianus lunaris (Forsk.), Swain.
Scomber madagascariensis, pl. 75,	590	Scombroides lysan (Forsk.), Swn.
Scomber[6] botla, . . .	591	?
Scomber leopardus, . .	591	Scomberomorus guttatus (Bl. and Sch.), Swain.
Scomber maculosus, . .	592	Scomberomorus commersonii (La C.), Swain.
Scomber[7] nigricollis, . .	597	Teuthis, sp.
Gasterosteus carolinensis, .	608	Trachynotus carolinus (L.), Gill.
Gasterosteus canadensis, .	609	Elacate canada (L.), Gill.

[redacted]

NAME.	PAGE.	IDENTIFICATION.
Trigla[1] japonica.	624	? Cephalacanthus, sp.
Genus Trachichthys.	630	Genus Trachichthys, Shaw.
Trachichthys australis,	630	Trachichthys australis, Shaw.

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NAME.	PAGE.	IDENTIFICATION.
Loricaria[2] accipenser,	36	Loricaria maculata, Bloch.
Loricaria dentata,	37	Loricaria cataphracta, L.
Loricaria flava,	38	Hypostomus plecostomus(L.), C&V.
Salmo[3] phinoc,	54	? Salmo trutta, L.
Salmo salmulus,	55	Salmo salar, L.
Salmo fulvus,	80	Sarcodaces odoë (Bloch), Günther.
Salmo rostratus,	86	Coregonus oxyrhynchus, L.
Esox barracauda,	105	Sphyræna picuda, Bl. & Sch.
Esox cepedianus,	pl. 110, 117	Lepidosteus tristæchus (Bl. & Sch.), J. & G.
Esox leverianus,	118	Lepidosteus tristæchus (Bl. & Sch.), J. & G.
Esox stomias,	120	Chauliodus sloanii, Bl. & Sch.
Polypterus niloticus,	pl. 112, 122	Polypterus bichir, Geoffroy.
Mullus[4] malabaricus,	137	? Mugil, sp.
Polynemus niloticus,	151	Polynemus plebejus, Gmel.
Polynemus indicus,	155	Polynemus indicus, Shaw.
Polynemus tetradactylus,	155	Polynemus tetradactylus, Shaw.
Polynemus commersonii,	156	Polynemus plebejus, Gmel.
Clupea gigantea,	173	Megalops cyprinoides (Brouss.), Bleeker.
Cyprinus[5] rondeletii,	pl. 123, 194	Cyprinus carpio, L.
Cyprinus[6] pomeranicus,	202	?
Cyprinus[7] ferrugineus,	pl. 131, 218	Cyprinus carpio, L.
Cyprinus punctatus,	220	Abramis bipunctatus (Bloch), Gün.
Cyprinus serta,	232	Abramis vimba (L.), C. & V.
Cyprinus lancastriensis,	234	Squalius leuciscus (L.), Heckel.
Petromyzon plumbeus,	263	Petromyzon branchialis, L.

[1] Based on *Trigla alata*, Gmel. Syst. Nat., 1346.

[2] *Loricaria accipenser* Shaw, includes *Loricaria maculata* Bloch, and *Loricaria cataphracta* L.

[3] Based on "White Salmon, Penn., Brit. Zool."

[4] Based on "*Peddarki Sovero* Russ. pisc., t 182."

[5] Apparently a monstrosity; based on "Rondel. aquat. 2, p. 155."

[6] Based on "*Cyprinus buggenhagii* Bloch, t. 95."

[7] Apparently a monstrosity; based on "Cyprin rouge-brun, Cépède, 6, p. 490."

NAME.	PAGE.	IDENTIFICATION.
Petromyzon bicolor,	263	Petromyzon branchialis, L.
Raja chagrinea,	281	Raja fullonica, L.
Raja fasciata,	pl. 143, 286	Myliobatis nieuhofii (Bl. & Sch.) C. & V.
Raja poecilura,	291	Pteroplatea micrura (Bl. & Sch.) Müll. & Henle.
Raja[1] diabolus,	291	? Dicerobatis giornæ (La C.), Günther.
Raja[2] maculata,	316	?
Raja[3] bicolor,	316	?
Raja thouiniana,	pl. 147, 318	Rhinobatus thouinianus (Shaw) Swain.
Raja cuvieri,	319	Raja clavata, L.
Squalus philippinus,	341	Cestracion philippi (Bl. & Schn.) Cuvier.
Squalus[4] denticulatus,	351	?
Squalus zebra,	352	Stegostoma tigrinum (L.), Günther.
Squalus semisagittatus,	361	Pristis cuspidatus, Latham.
Genus Spatularia,	362	Genus Polyodon, La Cépède.
Spatularia reticulata,	pl. 156, 362	Polyodon spathula (Walb.), J. & G.
Chimæra borealis,	pl. 157, 365	Chimæra monstrosa, L.
Chimæra australis,	pl. 158, 368	Callorhynchus australis (Shaw), Owen.
Lophius europæus,	pl. 161, 379	Lophius piscatorius, L.
Lophius cornubicus,	381	Lophius piscatorius, L.
Lophius muricatus,	pl. 162, 382	Halieutæa stellata (Walb.), C. & V.
Lophius rostratus,	pl. 163, 383	Malthe vespertilio (L.), C. & V.
Lophius[5] pictus,	pl. 165, 386	Antennarius multiocellatus (C.&V.) Günther, var. leucosoma Bleeker.
Lophius[6] marmaratus,	pl. 165, 386	Antennarius, sp.
Cyclopterus[7] pyramidatus,	pl. 167, 390	Cyclopterus lumpus, L.
Cyclopterus pavoninus,	pl. 167, 391	Cyclopterus lumpus, L.
Cyclopterus[8] bispinosus,	396	? Cotylis, sp.
Cyclopterus cornubicus,	397	Lepadogaster gouanii, La Cépède.

[1] Based on "Eereegoodee Tenkoo, Russel ind., t. 9."

[2] Based on "Temeree Russ. ind., t. 1."

[3] Based on "Nalla Temeree, Russ. ind., t. 2."

[4] Based on "Squale dentelé," La Cépède, i, 281 ; habitat unknown.

[5] "Pictus" is preoccupied.

[6] Not identified by recent writers ; "*marmoratus*" is preoccupied.

[7] Evidently a monstrosity.

[8] Based on *Cyclopterus nudus* Gmel., Syst. Nat., 1475.

NAME.		PAGE.	IDENTIFICATION.
Balistes[1] liturosus,		405	Monacanthus, sp.
Balistes sonneratii,		406	Balistes bursa, Bl. & Sch.
Balistes bicolor,	pl. 168,	407	Balistes conspicillum, Bl. & Sch.
Balistes virescens,		408	Balistes viridescens, Bl. & Sch.
Balistes fasciatus,		409	Balistes rectangulus, Bl. & Sch.
Balistes unimaculatus,		410	Balistes verrucosus, Bl. & Sch.
Balistes cinereus,		410	Balistes cinereus, Bonnat.
Balistes signatus,		416	Balistes fuscus, Bl. & Sch.
Balistes capistratus,		417	Balistes capistratus, Shaw.
Ostracion auritus,	pl. 173,	429	Aracana aurita (Shaw), Günther.
Ostracion striatus,		430	Aracana aurita (Shaw), Günther.
Diodon[2] liturosus,		436	Diodon liturosus, Shaw.
Cephalus brevis,	pl. 175,	437	Orthagoriscus mola (L.), Bl. Sch.
Cephalus varius,		439	Ranzania truncata (Retz), Nardo.
Cephalus pallasianus,		440	Orthagoriscus mola (L.), Bl. Sch.
Syngnathus foliatus,	pl. 180,	456	Phyllopteryx foliatus (Shaw), Swainson.
Pegasus draco,	pl. 182,	461	Pegasus draconis, Linnæus.

[1] Not identified by recent writers. "Native of the Indian seas: observed about the coasts of Otaheitee by Captain G. Tobin." (Shaw.)

[2] Based on *Diodon tachétè* La Cépède, ii, 13.

DECEMBER 26, 1882.

The President, Dr. LEIDY, in the chair.

Seventy-nine persons present.

Irregularities of the Dental Arch, etc.—Dr. HARRISON ALLEN called attention to the irregularity of the front and lateral curves forming the dental arch, and to some points in connection with the hard palate. He defined the curve of the teeth placed in the front of the jaw and answering to the premaxillæ, and those placed at the sides, the latter, pertaining to the maxillæ, having been found by him to be in the jaws of civilized whites always asymmetrical.

The folds (rugæ) of the hard palate are subject to much variation. In the human fœtus of five centimetres in length, they are regular, six in number, and arranged across the palate as in certain of the lower animals. At birth they have already become irregular, but as to how far such irregularity might exist without indicating deformity, he believed no data had been collected. The names canine, first intermediate, first bicuspid, second intermediate, second bicuspid, etc., were proposed for these rugæ. They are further arranged not infrequently in a median and a lateral set, an arrangement which is strikingly exhibited in some Quadrumana. When this arrangement appears in the human subject it may be accepted as an instance of reversion.

It was thought that a study of these rugæ, since they have systemic value in Cheiroptera, Insectivora and Quadrumana, might be undertaken in connection with other anthropological data. A series of plaster impressions of the dental arches and rugæ of young and adult heads of the different races, would be found of interest in this connection.

The disposition of the form of the wisdom-tooth to occasionally simulate the form of the premolar was commented upon.

The following papers were ordered to be printed:—

SOME ENCLOSURES IN MUSCOVITE.

BY H. CARVILL LEWIS.

In order to gain an insight into the method of occurrence of the crystals of biotite enclosed in muscovite, examples of which occur in several localities, the writer prepared, some seven years ago, a series of cleavage plates taken from a single crystal of muscovite and biotite. These sections, arranged in order consecutively from the base of the crystal upwards, are now delineated upon the accompanying plate, and exhibit several features of interest. The specimen figured is one of a number found at an opening in partially decomposed felspathic gneiss on Baltimore avenue, West Philadelphia. The decomposition which, due to exposure to atmospheric agencies, has more or less attacked all the minerals at this place, has either partially or completely altered the enclosed biotite into a hydrous exfoliating mineral, which, bearing the same relation to unaltered biotite as margarodite does to muscovite,[1] may be known as hydro-biotite.[2] The unaltered biotite is black, the hydro-biotite brown—both substances generally appearing in the same crystal.

The enclosed crystals of biotite have frequently well-defined edges, and contrast sharply with the surrounding white muscovite.

It is of interest to observe that, so far as noticed, the crystallographic axes of both muscovite and biotite are parallel, and their prismatic planes symmetrical. Where, owing to the imperfect development of the enclosing muscovite, this relation is not immediately perceptible, it may be rendered evident by producing in each substance a strike figure (*schlag figur*), by mechanical means. If a sharp-pointed steel rod is held lightly upon a thin piece of mica, and the rod is then struck quickly with a hammer, a hole is produced in the mica, from which radiate lines of cleavage in three directions. As Reusch has shown,[3] the cleavage in biotite (hexagonal) is parallel to the sides of the hexagon, while in

[1] *v.* Proc. Acad. Nat. Sc., Phila., 1880, p. 319.

[2] Margarodite being merely a hydrated muscovite, similar to it in all optical and physical characters, except such of the latter as are due to alteration, should properly be called *hydro-muscovite*.

[3] Monatsb. d. Konigl. Acad., Berlin, 1868, p. 428; 1869, p. 84.

muscovite (orthorhombic) two of the cleavage lines are parallel to the sides of the rhomb, and the third parallel to the shorter lateral axis (brachydiagonal). The two micas have, therefore, similar strike figures, the lines of one being parallel to those of the other. In each strike figure the lines cross each other at angles of 60°. If now a strike figure is produced close to the dividing line between the two micas, it will be seen that if the biotite is unaltered the cleavage lines run continuously from the one into the other without change of direction—a proof that the crystallographic planes of the two micas also have the same direction. This fact has already been shown by Gustav Rose[1] in a specimen of biotite in muscovite from Alstead, N. H.

Since, therefore, the two micas have symmetrically arranged prismatic planes, it is probable that they have been crystallized together out of the same solution.

A close examination of the accompanying plate, exhibiting a continuous *vertical* section of the crystal, shows that while the edges of both crystals remain parallel in successive plates, the substance of the biotite is gradually absorbed or eaten away, and replaced by the encroaching muscovite as the summit of the biotite crystal is approached. In fig. 1 the nearly perfect black crystal of biotite is seen to occupy a large space within the muscovite. Fig. 2 shows a small patch of white muscovite within the black crystal, while in figs. 3 and 4 this small patch is seen to become [redacted]

These well-known and often very beautiful markings form a series of branching lines, which run in three directions across the plates of mica, sometimes resembling the frost figures upon a window pane. The lines of the figures cross each other at fixed angles of $60°$, and from their similarity to crystalline forms, have been hitherto regarded by mineralogists as the result of repeated twinning around a dodecahedral axis,[1] and have been correlated with the dendritic crystallizations of native gold and copper.[2] As shown, however, by the writer in 1877,[3] these markings always bear a fixed relation to the crystallographic axes of the muscovite, and are not due to an inherent property of the magnetite.

If a crystal of muscovite enclosing reticulated magnetite be dissected into a series of successive cleavage plates, it will be found that the markings throughout are confined to similar portions of the crystal and that the three directions of the lines are maintained at the same angle throughout the whole crystal. Some common cause has produced the parallelism of the lines in successive plates. On the other hand, it will be seen that there is no direct connection between any one cleavage plate and that next above or below it. One plate may be covered with markings, and the next plate entirely free from them, while the third plate will be again covered with markings, which, quite unlike the first plate in appearance and arrangement, yet form the same angles with the exterior of the crystal. Unlike the enclosed crystals of biotite, which *penetrate* the muscovite through successive plates, the reticulated magnetite is superficial, and rests upon the separate plates of muscovite in disconnected dendritic patches. The following drawing represents four successive plates of muscovite with reticulated magnetite, and shows the independence yet correlation of these markings. Lamina No. 2, which lay immediately below No. 1, is almost free from markings, while Nos. 3 and 4, cleft from the lower side of No. 2, show that the arrangement of the markings is entirely different on each lamina, although they maintain the same direction on all four. The strike figure, common to all four laminæ, is shown in the centre of the drawing. The specimen figured was obtained in Delaware, near the Pennsylvania line.

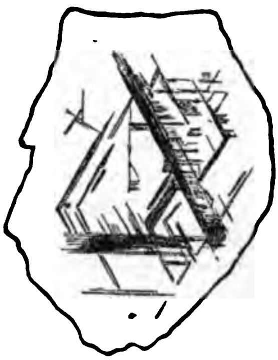
[1] J. D. Dana, System of Mineralogy, p. 150.

[2] E. S. Dana, Text book of Mineralogy, p. 93.

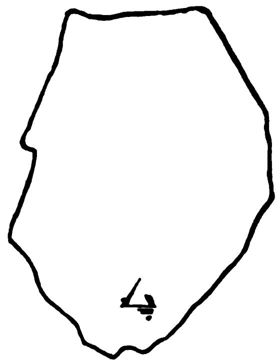
[3] Proc. Min. and Geol. Section, Acad. Nat. Sc., June 25, 1877.

Although always resting upon the plates of mica as very thin dendrites, the magnetite has not been derived from any external source, but evidently from the muscovite itself. The markings do not occur along lines of cracks or near the edges of the crystal, but lie in regular groups in the interior. They are not dendrites in the sense of being the result of any infiltration, and the term "dendrite" should therefore not be applied to them. They are true

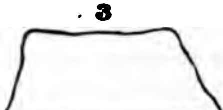
1



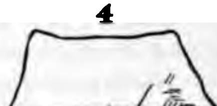
2



3



4



[redacted]

that in all cases the markings are parallel with the lines of the strike figures. In the drawing given above, the strike figure is inserted between the figures of the muscovite, and this parallelism of direction is clearly seen.

It is thus interesting to find that a blow given with a sharp instrument was necessary to bring out lines which were previously recognized and followed by the more sensitive magnetite in its growth. Just as beryls and tourmalines and quartz crystals are flattened and garnets are laminated by the enclosing mica, so the magnetite is influenced to follow the crystallographic lines of the parent mineral. Such forms might well be designated *allomorphic*. The weaker mineral is compelled into another habit by the stronger one.

It should be mentioned that occasionally the magnetite follows lines of the natural cleavage of the muscovite, such lines being at right-angles to the lines produced in the strike figure. Fig. 1, in the preceding cut, shows these secondary lines in addition to the more prominent lines which are parallel to the strike figure.

In conclusion, then, it appears that both biotite and magnetite, when enclosed in muscovite, conform in their directions to the crystallographic planes of the latter; and that while biotite penetrates through successive plates of the muscovite, and is frequently altered into it, magnetite, on the other hand, is purely superficial and forms different markings upon each lamina of mica.

ON THE VALUE OF THE "NEARCTIC" AS ONE OF THE PRIMARY ZOOLOGICAL REGIONS.

BY PROFESSOR ANGELO HEILPRIN.

The six zoological regions[1] laid down by Mr. Sclater, and so admirably sketched out by Mr. Wallace, have been so very generally accepted by naturalists that it may be considered as almost presumptuous for any one to attempt at this late hour a revision of the same. But yet the evidence concerning the position of at least one of these—the Nearctic—is in many respects so negative—indeed, it might be said so directly contradictory—that a reconsideration is rendered almost imperative. The question affecting the relationship of this region is thus stated by Wallace: "Whether the Nearctic region should be kept separate, or whether it should form part of the Palæarctic or of the Neotropical regions. Professor Huxley and Mr. Blyth advocate the former course; Mr. Andrew Murray (for mammalia) and Professor Newton (for birds) think the latter would be more natural. No doubt much is to be said for both views, but both cannot be right; and it will be shown in the latter part of this chapter that the Nearctic region is, on the whole, fully as well defined as the Palæarctic, by positive characters which differentiate it from both the adjacent regions."[2]

[1] Palæarctic, Ethiopian, Indian (Oriental of Wallace), Australian, Nearctic, and Neotropical (Austro-Columbian of Huxley).

[2] Geographical Distribution of Animals, vol. 1, p. 66, 1876. Professor Newton, in the article "Birds," contained in the Encyclopædia Britannica (9th ed., iii, p. 751, 1875), thus expresses his views in the present connection: "Thus, regarded simply from an ornithologist's point of view, what we call the Nearctic 'region,' seems to have no right to be considered one of the primary regions of the earth's surface, and to be of less importance than some of the subregions of the Neotropical region. * * * It is not, however, intended here to question the validity of the Nearctic region in a zoögeographical sense. If that position could be successfully disputed, it must be done on more than ornithological grounds, and a consideration of them would be out of place in this article. It is enough to mention that though the mammals would possibly lead to much the same conclusion as the birds do, yet the lower classes of vertebrates—reptiles, amphibians and fishes—would most likely have a contrary tendency, while the present writer is quite unable to guess at the result which would be afforded by the invertebrates."

In view of the very divergent positions occupied by the naturalists above cited as to the value of the region here referred to, it may be fairly conceded, we believe, and with due deference to the high authority of Mr. Wallace, that the question of position or relationship is still an open one; and the more especially can this be considered to be the case, since several of the authors do not appear to be agreed even as to the general (or preponderating) relationship of the contained mammalian fauna, or that branch of the representative fauna which is usually taken to be most characteristic (typical) of a region.[1]

In the hope, therefore, of throwing some additional light on this subject the author has been constrained to make the following critical inquiry. The points which it has been attempted to solve are:—

1. Whether the Nearctic region is entitled to be considered as an independent region by itself.

2. If not, of which region, Palæarctic or Neotropical, does it constitute a part.

The relative relationship of the Nearctic fauna with the faunas of the Palæarctic and Neotropical regions constitutes the first portion of the inquiry.[2]

The Nearctic mammalian fauna comprises, according to Wallace, about 26 families, as follows:

Phyllostomidæ,	Suidæ,
Vespertilionidæ,	Cervidæ,
Noctilionidæ,	Bovidæ,
Talpidæ,	Muridæ,
Soricidæ,	Dipodidæ,
Felidæ,	Saccomyidæ,

[1] Wallace, *op. cit.*, 1, p. 57.

[2] In the following analyses of mammalian families, genera and species, the author has followed the tables furnished by Wallace in his "Geographical Distribution of Animals," and for two reasons: 1st, The circumstance that these tables have served as the basis for Mr. Wallace's own conclusions, *et conseq.* as the guiding data for those authors who have accepted the views of this naturalist; and 2d, The difficulty of constructing new tables, which in their application to all the various zoögeographical regions, could claim a decided advantage over those that are here furnished. For the North American fauna a reconsideration based upon the more recent works of Coues and Allen, where the number of species is very materially reduced, is given later on.

Canidæ,	Castoridæ,
Mustelidæ,	Sciuridæ,
Procyonidæ,	Haploödontidæ,
Ursidæ,	Cercolabidæ,
Otariidæ,	Lagomyidæ,
Trichechidæ,	Leporidæ,
Phocidæ,	Didelphyidæ.

Of this number only one family—the *Haploödontidæ*—comprising one or two species of beaver-like animals inhabiting the west coast, can be said to be strictly peculiar to the region.[1] Of the 25 non-peculiar families, 19 are also Palæarctic, and of the remaining 6, 5 are exclusively Nearctic and Neotropical and 1 (*Noctilionidæ*, or short-eared bats) is found in the eastern hemisphere.

Comparing the Nearctic with the Neotropical fauna, we find that out of the 25 non-peculiar families 18 are also Neotropical, so that the relationship between the Palæarctic and the Nearctic on one side, and the Nearctic and Neotropical on the other, would appear to be equally great. But if we take the genera included in these 26 families (74 in all[2])

[1] The *Saccomyidæ*, or pouched rats, which are also regarded as peculiar to the Nearctic region by Wallace, can scarcely be considered such, since a fair proportion of the species (*Heteromys*, 6 sp. ? ; *Geomys* [*Geomyidæ* of some authors]) penetrate to a considerable distance within the Neotropical region. The family is more properly *characteristic* than *peculiar*.

	Number of Species.		Number of Species.
[2] Phyllostomidæ,		Soricidæ,	
Macrotus,	1	Sorex,	16
Vespertilionidæ,		Neosorex,	1
Scotophilus,	5	Blarina,	7
Vespertilio,	6	Felidæ,	
Nycticejus,	1	Felis,	5
Lasiurus,	3	Lynx,	3
Synotus,	2	Canidæ,	
Antrozous,	1	Lupus,	6
Noctilionidæ,		Vulpes,	6
Nyctinomus,	1	Mustelidæ,	
Talpidæ,		Martes,	2
Condylura,	1	Mustela,	11
Scapanus,	2	Gulo,	1
Scalops,	3	Latax,	2
Urotrichus,	1	Enhydris,	1

we find that 35 are also Palæarctic,[1] and only 21 Neotrop-

	Number of Species.
Taxidea,	2
Mephitis,	6
Procyonidæ,	
Procyon,	2
Bassaris,	1
Ursidæ,	
Ursus,	3
Otariidæ,	
Callorhinus,	1
Zalophus,	1
Eumatopias,	1
Trichechidæ,	
Trichecus,	1
Phocidæ,	
Callocephalus,	1
Pagomys,	1
Pagophilus,	1
Halicyon,	1
Phoca,	1
Halichœrus,	1
Morunga,	1
Cystophora,	1
Suidæ,	
Dicotyles,	1
Cervidæ,	
Alces,	1
Rangifer,	2
Cervus,	6
Bovidæ,	
Bison,	1
Antilocapra,	1
Aplocerus,	1
Capra,	1
Ovibos,	1

	Number of Species.
Muridæ,	
Reithrodon,	5
Hesperomys,	16
Neotoma,	7
Sigmodon,	2
Arvicola,	27
Myodes,	3
Fiber,	1
Dipodidæ,	
Jaculus,	1
Saccomyidæ,	
Dipodomys,	5
Perognathus,	6
Thomomys,	2
Geomys,	5
Saccomys,	1
Castoridæ,	
Castor,	1
Sciuridæ,	
Sciurus,	18
Sciuropterus,	4
Tamias,	4
Spermophilus,	15
Cynomys,	2
Arctomys,	4
Haploödontidæ,	
Haploödon,	2
Cercolabidæ,	
Erethizon,	2
Lagomyidæ,	
Lagomys,	1
Leporidæ,	
Lepus,	15
Didelphyidæ,	
Didelphys,	2

In Wallace's table of the Palæarctic fauna, *Thalassarctos*, the polar bear, is considered as a distinct genus apart from *Ursus*. The Nearctic *Ursidæ* would accordingly be *Ursus*, 2 species, and *Thalassarctos*, 1 species.

[1] Vespertilio,
Urotrichus,
Sorex,
Felis,
Lynx,
Lupus,
Vulpes,
Halichœrus,
Cystophora,
Alces,
Rangifer,
Cervus,
Bison,
Capra,

ical.[1] Of these 21, moreover, 6 belong to the volant mammalia —the bats—a class of animals possessing special means for self-distribution.

It will thus be seen that *generically* the North American mammalian fauna is much more intimately related to the Eur-Asiatic than to the South American.

Furthermore, of the 35 genera also occurring in the Palæarctic region, 21 are found nowhere else but in that region—in other words, 21 out of 74 genera are peculiar to the combined Nearctic and Palæarctic regions.[2] On the contrary, of the 21 Neotropical

Martes,	**Arvicola,**
Mustela,	**Myodes,**
Gulo,	**Castor,**
Ursus,	**Sciurus,**
Callorhinus	**Sciuropterus,**
Zalophus,	**Tamias,**
Trichecus,	**Spermophilus,**
Callocephalus,	**Arctomys,**
Pagomys,	**Lagomys,**
Pagophilus,	**Lepus.**
Phoca,	

[1]

Macrotus,	**Bassaris,**
Scotophilus,	**Dicotyles,**
Vespertilio,	**Cervus,**
Nycticejus,	**Reithrodon,**
Lasiurus,	Hesperomys,

[redacted]

nera occurring in the Nearctic fauna, only 11 are exclusively eotropical. In other words, only 11 out of 74 genera are pecuar to the combined Nearctic and Neotropical regions.[1] Again, ie 21 Nearctic-Palæarctic genera are represented by about 69 pecific forms, whereas the 11·Nearctic-Neotropical genera have only about 39 specific representatives. So that, whichever way considered, there is a great preponderance of Palæarctic, as compared to Neotropical, forms in the Nearctic fauna. As far as the evidence afforded by the mammalia is concerned, therefore, there is a much closer relationship shown to exist between the North American (Nearctic) and Eur-Asiatic (Palæarctic) faunas than between the former and the South American (Neotropical).

It is thus manifest, that if the Nearctic fauna is not a distinct one, it should be united—if judged by its mammalian fauna alone—with the Palæarctic rather than with the Neotropical. But the question still remains, is it a distinct fauna, or is it only a lateral extension of the Palæarctic?

It has already been stated that the region possesses among 26 families of mammalia only one that is strictly peculiar to it—the *Haploödontidæ*.

The Neotropical, on the other hand, has out of about 31 families, 8 that are peculiar.[2]

The Australian, of 22, likewise 8.[3]

The Ethiopian, out of 44, 9 that are peculiar.[4]

The only other regions that can compare with the Nearctic in the paucity of their peculiar families are the Palæarctic and the Oriental, the former represented by 36 families, with not a single one peculiar, and the latter likewise with 36 families, of which

[1] Macrotus, Lasiurus, Enhydris, Mephitis, Procyon, Bassaris, Dicotyles, Reithrodon, Hesperomys, Fiber, Didelphys.

[2] *Cebidæ, Hapalidæ, Phyllostomidæ* (one species in California), *Chinchillidæ, Caviidæ, Bradypodidæ, Dasypodidæ, Myrmecophagidæ.*

[3] *Dasyuridæ, Myrmecobiidæ, Peramelidæ, Macropodidæ, Phalangistidæ, Phascolomydæ, Ornithorhynchidæ, Echidnidæ.*

[4] *Cheiromyidæ, Centetidæ, Potamogalidæ, Chrysochloridæ, Cryptoproctidæ, Protelidæ, Hippopotamidæ, Camelopardidæ, Orycteropodidæ.*

number only 3 are peculiar.[1] But the paucity of peculiar families in the case of the Palæarctic and Oriental regions is readily explained by the circumstance that both regions are bounded along the line of their greatest development by other faunal regions, with which an exchange in forms will naturally be effected. Thus the Palæarctic region is bounded along an extent of about 140 degrees of longitude, or about 9000 miles, by the Ethiopian and Oriental regions. The proportions of bounding surface to area is perhaps still greater in the case of the Oriental region. But in the case of the Nearctic region (as recognized) we have no such bounding surface—in fact we are here limited for our exchanges to the narrow strip (Mexico, Central America) uniting the two great continents—and, therefore, on the assumption of a distinct fauna it would be doubly difficult to assign a special explanation for the very limited number of peculiar families.

While the Nearctic and Palæarctic regions are each deficient in peculiar mammalian families, yet they are eminently distinguished from their nearest faunal neighbors by certain highly characteristic families, which are only rendered *non*-peculiar by the circumstance that they are contained in both regions. Such are the

1. Talpidæ, ...	Moles.
2. Trichechidæ, ...	Walruses.
3. Castoridæ, ...	Beavers.

[redacted]

alone, and would then stand in nearly the same relation by family distinctions to the other regions as the Neotropical, Ethiopian, and Australian. The combined Nearctic and Palæarctic regions would, moreover, be further united to each other by the negative character afforded in the almost total absence of the *Quadrumana*[1] and *Edentata*, orders which are abundantly represented in all the other regions but the Australian.

If now we turn to an examination of the genera peculiar to the several zoögeographical regions, we find that out of a total of 74 represented in the Nearctic, only about 26 are restricted to that region, forming 35 per cent.

In the Palæarctic, out of 100—35 peculiar = 35 per cent.

In the Oriental, out of 118—54 peculiar = 46 per cent.

In the Australian, out of 70—45 peculiar = 64 per cent.

In the Ethiopian, out of 142—90 peculiar = 63 per cent.

In the Neotropical, out of 131—103 peculiar = 78 per cent.

We here again note a deficiency in the case of the Nearctic and Palæarctic regions—an absence of positive distinguishing characters—a condition to be explained by the fact that a very considerable number of genera are rendered non-peculiar (just as in the case of the families) by the circumstance of their being represented in both the Nearctic and Palæarctic regions. But if we consider the two regions as forming in reality but one, we would have in addition to the 26 Nearctic and the 35 Palæarctic genera already referred to, 22 additional ones to be comprised in the regions as being peculiar to it, viz.:—

Genera.	Represented by Palæarctic species.	Nearctic.
Urotrichus, ...	1	1
Lyncus, ...	9	3
Gulo, ...	1	1
Thalassarctos, . . .	1	1
Zalophus, ...	1	1
Eumatopias, ...	1	1

[1] About 5 species of Quadrumana, representatives of the genera *Macacus* and *Semnopithecus*, enter within the confines of Palæarctic regions. The highest latitude in the northern hemisphere reached by this class of animals is probably the Rock of Gibraltar (Lat. 36°), inhabited by the Barbary ape (*Macacus inuus*); the genus is also represented in Japan. Three or four species of Quadrumana (*Macacus, Cynopithecus*) likewise occur in the islands Timor, Batchian, and Celebes, belonging to the Australian region.

Genera.	Represented by Palæarctic species.	Nearctic.
Trichechus,	1	1
Callocephalus,	3	1
Pagomys,	2	1
Pagophilus,	2	1
Phoca,	2	1
Halichœrus,	1	1
Cystophora,	2	2 (?)
Alces,	1	1
Tarandus,	1	2
Bison,	1	1
Cuniculus,	1	1
Myodes,	1	3
Castor,	1	1
Spermophilus,	10	15
Arctomys,	4	4
Lagomys,	10	1
	57	45

To which may also be added *Capra* (with 10 Palæarctic species), *Ovis* (with 10 Palæarctic and 1 Nearctic species), and *Arvicola* (with 21 Palæarctic and 27 Nearctic species), genera whose representatives but barely pass beyond the confines of the region— [redacted]

In the Australian, of 243 species, the 45 peculiar genera comprise 151 = 62 per cent.

In the Ethiopian, of 525 species, the 90 peculiar genera comprise 288 = 55 per cent.

In the Neotropical, of 634 species, the 103 peculiar genera comprise 376 = 60 per cent.

So here, again, just as in the case of families and genera, the Nearctic and Palæarctic regions show a very decided deficiency, the specific types that ought to characterize a fauna being but very feebly developed. But if we unite the two regions, the negative character is developed into a positive one by the incorporation of a considerable number of species representing the 25 genera, which are held in common by the two regions. The number of species held by the Nearctic region has been stated to

be about	279
And of the Palæarctic, ...	426
	705
Less 30 species (as will be seen further on) held in common,	30
Total for the combined region, ...	675

Of this total of 675 species for the combined region we have:—

60 represented by the genera peculiar to the Nearctic region;
71 represented by the genera peculiar to the Palæarctic region;
153 (171—18 common = 153) represented by the 25 peculiar genera common to the two regions;

284

Or a proportion of species representing the peculiar genera of 284 : 675 (42 per cent.), a ratio sufficiently large to impress upon the fauna a distinctive character.

In our estimates of the Nearctic fauna we have relied upon the tables furnished by Wallace. If instead of these, however, we avail ourselves of the later data furnished by the various papers of Coues and Allen, the result will not be materially altered. According to the lists furnished by these authorities it would appear that the Nearctic mammalian fauna has, instead of 279 species, only about 210.

Two new families,[1] and three new genera[2] (of which one is peculiar) are indicated.

Out of a total of 75 genera, 27 are peculiar, which would give a proportion (36 per cent.) very little different from that deduced from Wallace's data.

These 27 peculiar genera, again, are represented according to Coues' table by about 49 species, which, out of the total of 210, would give 23 per cent. of the entire fauna, or $1\frac{1}{2}$ per cent. over that which was found in our first estimation.

Again, uniting the Palæarctic and Nearctic regions with the new data, we find, instead of a total of 705 species, only 636

Deducting 30 species held in common, ... 30

Total, ... 606

Of this total of 606 species for the combined regions we have:

71 species represented by the genera peculiar to the Palæarctic region;

49[3] species represented by the genera peculiar to the Nearctic region;

132 species (150[4]—18 = 132) represented by the 25 genera peculiar to the two regions;

252

or a proportion of species representing the peculiar genera of 252 : 606 = 42 per cent., or precisely the figure that was obtained from Wallace's tables.

The following species of North American mammalia are generally considered to be identical with Palæarctic forms, or, at any rate, to have such close Eur-Asiatic representatives as to be but doubtfully distinguishable from them:

Evotomys (Arvicola) rutilus,	Putorius erminea,
Myodes Obensis,	? Putorius vison,
Cuniculus torquatus,	Felis Canadensis,

[1] *Zapodidæ, Geomyidæ.*

[2] *Ochetodon* (*Hesperomys*, pars), *Evotomys* (*Arvicola*, pars), *Cricetodipus* (*Perognathus*, pars).

[3] Instead of the 60 before recorded, corresponding to the general reduction in the number of species.

[4] 98 Palæarctic; 52 Nearctic.

Lepus timidus,
Castor fiber,
Tamias Asiaticus,
Spermophilus empetra,
? Arctomys pruinosus,
? Urotrichus Gibbsi,
Cervus Canadensis,
Alce malchis,
Tarandus rangifer,
Gulo luscus,
? Mustela Americana,
Putorius vulgaris.
Canis occidentalis,
Vulpes vulgaris,
Ursus Americanus
(et U. horribilis?)
Phoca vitulina,
Cystophora cristata,
Callorhinus ursinus,
Zalophus Gillespii,
Trichecus rosmarus,
Pagophilus Groënlandicus,
Halichœrus sp.

And perhaps a little less certain,

Ovis montana. Bison Americanus.

From the preceding facts it may be considered as shown, 1st, that by family, generic and specific characters, as far as the mammalia are concerned, the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other regions than either the Nearctic or Palæarctic taken individually; and 2d, that by the community of family, generic, and specific characters the Nearctic region is indisputably united to the Palæarctic, of which it only forms a lateral extension.

Evidence Afforded by the Batrachia and Reptilia.

If we now turn to the evidence afforded by the batrachians and reptiles, we will find the conclusions drawn from the study of the mammals to be strikingly confirmed.[1]

Batrachia Urodela.

The following families are enumerated in the Nearctic fauna (as usually recognized):

[1] In the following zoögeographical considerations the "Sonoran" subregion of Prof. Cope, including "parts of Nevada, New Mexico, Arizona, and Sonora in Mexico" (Bulletin U. S. National Museum, i, p. 68, 1875), is taken to represent a portion of the Neotropical region, and for reasons that will be stated further on. To this section detached from the Nearctic region will probably have to be added the peninsula of Lower California (the "Lower Californian" subregion of Cope), and portions of California and Texas.

Sirenidæ, ... Peculiar to the Nearctic.

Siren, 1 species.

Pseudobranchus, 1 sp.

Proteidæ, ... Palæarctic.

Menobranchus, 2 sp.

[Palæarctic, *Proteus.*]

Amphiumidæ, ... Peculiar to the Nearctic.

Amphiuma, 1 sp.

Muræenopsis, 1 sp.

Menopomidæ, ... Palæarctic.

Menopoma, 2 sp.

[Palæarctic, *Sieboldia.*]

Amblystomidæ, ... Palæarctic.

Amblystoma.[1]

Dicamptodon, 1 sp.

[Palæarctic, *Onichodactylus*, *Ranodon.*]

Plethodontidæ, . . . Neotropical, . . Palæarctic.

7–8 genera, with about 22 species. The genus *Spelerpes*, with about 8 species, descends beyond the Nearctic boundary into northern South America; it is also represented by a solitary species in southern Europe.

Desmognathidæ, ... Peculiar to the Nearctic.

Desmognathus, 3 sp.

[redacted]

Batrachia Anoura.

Bufonidæ, ... Nearly cosmopolitan.
  Bufo.
Engystomidæ, . . . Tropical, Old and New World.
  Engystoma, 1 species.
Hylidæ, . . Essentially tropical, Old and New World.
  Acris, 1 sp.
  Chorophilus, 4 sp.
  Hyla, about 12 species, several of which occur in the Sonoran region or along the Neotropical boundary.
Scaphiopidæ, ... Palæarctic.
  Spea.
  Scaphiopus.
Cystignathidæ, . . . Neotropical, . . Australian.
  2 species, both in the Sonoran subregion.
Ranidæ, ... Essentially Old World.
  Rana, 8 sp.

The above data will show that the anourous or tailless batrachians scarcely afford any positive indications as to the zoögeographical position of the region in which they occur. Yet in several respects there is a very decided leaning toward the Palæarctic. Thus it agrees with the Palæarctic in the paucity of its Bufonic element, the genus *Bufo*, which comprises about 80 species, having only about 4–5 Nearctic specific representatives (if we exclude the 6–7 species found in the Sonoran districts), and about an equal number in the Palæarctic region.

Again, in the case of the *Ranidæ*, an eminently Old World family of batrachians, we have, just as in the Palæarctic region, *only one* generic representative—*Rana*—which, with about 5–6 species, but barely penetrates within the Neotropical region. Of about 108 species comprised by the genus, 8–9 belong to the Nearctic fauna, and about an equal number, 10–11, to the Palæarctic.[1] In addition to this general similarity existing between the Nearctic and Palæarctic faunas as exemplified by the *Ranidæ*, we have the further one that at least one species of the genus *Rana*[2] is common to both regions; and another Palæarctic species

[1] Boulenger, "Catalogue of the Batrachia Salientia" of the British Museum, 2d ed., 1882.

[2] *Rana temporaria* (*R. sylvatica*).

has a closely related Nearctic representative.[1] On the other hand, in the peculiarly Neotropical or tropical (in general) groups of anourous batrachians the Nearctic province is remarkably deficient. Thus of the *Engystomidæ* we have but a solitary representative, *Engystoma Carolinense*. Of the *Cystignathidæ*, which comprises upwards of 130 Neotropical forms, we have only two[2] Nearctic species, and both of these are found just beyond the confines of the region—southern Florida and along the lower Rio Grande. There is a somewhat greater development of the genus *Hyla* of the *Hylidæ* than might have been looked for, but the genus, while it may have but one really good species, is at least represented by several very well marked varieties (variously considered to be distinct species) also in the Palæarctic region.

Ophidia.

The Nearctic serpents are comprised in 4 or 5 families—*Crotalidæ* (with about 19 species), *Colubridæ*, *Elapidæ*, *Boidæ*, and *Lichanuridæ*. The first of these being an essentially American and Oriental (!) group (a few species penetrating within the Palæarctic region), can scarcely carry much weight in the matter of zoögeographical classification. The *Elapidæ* and *Boidæ* (with 3 and 2 species respectively) are tropicopolitan, and their North American representatives but barely enter the Nearctic region. The two species of the genus *Charina* (*Boidæ*) are moreover found in that section of the United States—Nevada and Lower California—which in our estimation ought to be separated from the Nearctic region. This is likewise the case with the 3 species of *Lichanura* (Lower California), which constitute the family *Lichanuridæ*. The only and most important family that remains to be specially considered is that of the *Colubridæ*. Of this cosmopolitan family we have about 107 Nearctic species; of this number about 30 belong to genera almost exclusively restricted to the Sonoran and Californian regions. Of the remaining 77, a very large proportion (more than one-half) *belong to essentially Old World genera*—*Coluber*, *Tropidonotus* (*Eutaenia*), and *Coryphodon* (*Bascanion*)—and *principally to such as have no South American* representatives, as *Coluber* and *Tropidonotus*.[3]

[1] *Rana esculenta* in *R. halecina*.

[2] *Lithodytes Ricordii* and *Epirhexis longipes*.

[3] The range of *Tropidonotus* extends to Guatemala.

Lacertilia.

The following are the lacertilian families occurring in the Nearctic region (as recognized):—

Amphisbænidæ, ... Almost cosmopolitan.
1 species in the Florida subregion.

Anniellidæ, ... Peculiar to the Nearctic ?
1 sp. in California.

Scincidæ, ... Cosmopolitan.
14 species, 13 of which belong to the Old World genus Eumeces (or *Plestiodon*).

? Lacertidæ, ... Old World.
Xantusia, 1 sp. on the Pacific coast.

Zonuridæ (*Anguidæ*, *pars*), ... Old World.
Opheosaurus, 1 sp.

Teidæ, ... Essentially Neotropical.
A South American family of about 12 genera and 75 species, represented in the Nearctic region by 7 species, all of which, with one or two exceptions, are confined to the Sonoran and Californian provinces.

Gerrhonotidæ, ... Neotropical.
7 sp., confined to the Sonoran, Californian and Pacific subregions, and Western Texas.

Helodermidæ.
1 sp., confined to the Sonoran subregion.

Iguanidæ,. . . . . Neotropical.
An essentially Neotropical family, with about 50 genera and 150 species. Represented in the Nearctic region by about 40 species, *all of which, with two or three exceptions*, are confined to the Sonoran and Californian regions, or but just pass beyond the limits of these.

Anolidæ, ... Neotropical.
An essentially Neotropical family, with upwards of 70 species, and with only 1 or 2 Nearctic representatives.

Geckotidæ, ... Essentially tropical. But sparingly represented in either the Palæarctic or Nearctic regions; the 5 Nearctic species being all restricted to the Sonoran and Lower Californian subregions, and the extremity of the peninsula of Florida.

An analysis of the above table shows two facts very distinctly: 1. That the South American (Neotropical) forms of lacertilians—*Teidæ*, *Iguanidæ*, *Anolidæ*—stop *almost immediately* on the borders of the Nearctic region, sending but an extremely limited number of representatives beyond the Sonoran subregion; and 2. The *very great paucity* of lacertilian forms in general throughout the great mass of the North American continent. Excluding the Sonoran and Californian provinces, and the immediate border-line of the region, there would appear to be in all *but about 20 species* of Nearctic saurians, *13 of which belong to the Old World* genus *Eumeces!* The most widely diffused form of North American *Eumeces*, moreover, is a Palæarctic species![1] A further relationship with the Palæarctic fauna is maintained by *Opheosaurus*, the only New World representative of the "glass snakes."

Chelonia.

The special leaning of the Nearctic fauna to that of the Old World is as clearly indicated by the chelonians as by any of the other groups of animals that have thus far been considered. Of the 7 non-marine families represented,[2] 3—*Trionychidæ*, *Malaclemmydæ*, *Cistudinidæ*—are *distinctively* Old World groups, and two of the others, *Emydidæ* and *Testudinidæ*, are essentially so. One family, the *Cinosternidæ*, is peculiar to the North American continent. The *Chelydridæ* have one generic representative in the Palæarctic region (China), if *Platysternum* be considered (as by Agassiz) to belong to that family.[3]

[1] *Eumeces fasciatus*. Japan.

[2] *Trionychidæ, Chelydridæ, Cinosternidæ, Emydidæ, Malaclemmydæ, Cistudinidæ, Testudinidæ.*

[3] Constituted the type of a distinct family, *Platysternidæ*, by Gray ("Supplement to the Catalogue of Shield Reptiles," p. 69, 1870).

Faunal characters defining the Sonoran and Lower Californian subregions of Prof. Cope as distinct from the Nearctic region proper, and as a portion of the Neotropical.

1. Of the 8 families of Nearctic (so-called) urodele batrachians, only 2 are represented in this portion of the continent—*Amblystomidæ* and *Plethodontidæ*—and each of these only by one or two species. Out of a total of about 54 species, therefore, this region has *only about 3!*

2. More than one-half of all the Nearctic *Bufonidæ* are found in this region, "this being the headquarters of that genus [*Bufo*] in the Regnum Nearcticum."[1] Of about 20 Nearctic representatives of the *Hylidæ* we have here but 3; and likewise only one or two of the *Ranidæ*. The Sonoran and Lower Californian tailless batrachian fauna is thus shown to be distinct by both positive and negative characters from that of the Nearctic in general.

3. The serpent fauna comprises 22 genera, of which *10–11 are peculiar*.[2] 11 out of the 13 species and subspecies of Nearctic rattlesnake (*Crotalus*) are found here, and 7 of these nowhere else. *Coluber* is not represented.

4. Of about 55 species of lacertilians, about 46 belong to the Neotropical families *Iguanidæ*, *Teidæ*, and *Gerrhonotidæ*, and 4 to the tropical *Geckotidæ*. 11 out of the 20 genera represented are not found in any other portion of the Nearctic realm, or, at any rate, at no distantly removed part.[3]

5. Only 4–5 species of non-marine *Testudinata* are recorded,[4] 2 of which (*Cinosterna*) "are of Mexican type."

Conclusion.

In conclusion it may be briefly stated that, by the community of its mammalian, batrachian and reptilian characters, the Nearctic fauna (excluding therefrom the local faunas of the Sonoran and

[1] Cope, Bull. U. S. National Museum, i, p. 74, 1875.

[2] *Gyalopium, Chionactis, Sonora, Rhinochilus, Chilopoma, Trimorphodon, Hypsiglena, Phimothyra, Chilomeniscus, Lichanura,* and *Charina* (one species of the last passes into the adjoining "Pacific" subregion).

[3] *Heloderma, Sauromalus, Uma, Coleonyx, Verticaria, Diplodactylus, Cyclura, Dipsosaurus, Callisaurus, Uta,* and *Phyllodactylus.*

[4] Up to the time of the publication of Prof. Cope's "Check List," 1875.

Lower Californian subregions, which are Neotropical[1]) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæarctic (of which it forms only a lateral extension).

The Palæarctic (Old World) affinities are further maintained in the land and fresh-water mollusca, and not only by a considerable number of representative (identical) specific types common to both regions, circumpolar, subboreal, and otherwise, but by the presence (and extensive development in most cases) of the characteristic genera *Physa*, *Planorbis*, *Limnæa*, *Paludina*, *Vivipara*, *Valvata*, and *Bythinella*, forms not at all, or but very sparingly, represented in the Neotropical realm.[2] The *Lepidoptera* among insects carry equally strong evidence in this direction, for, as Wallace justly remarks,[3] while the Nearctic fauna embraces a number of distinct types, and the Neotropical element is sufficiently well represented in the southern United States, "still, we must acknowledge, that if we formed our conclusions from the butterflies alone, we could hardly separate the Nearctic from the Palæarctic region."[4]

[1] It is very probable that portions of California, Texas, and Florida will have to be relegated to the Neotropical realm.

[2] The very great development of the *Strepomatidæ*, or New World melanians, in the waters of the Nearctic region, might be urged as a claim for recognizing the independence of this region. But for this reason alone an equal claim might be set up for considering the eastern and western United States as constituting two distinct realms, since this group of mollusks is pretty effectually limited in its distribution by the Mississippi River, none or but very few of the forms passing west of the river, except in the region of its upper course.

[3] Geog. Distr. of Animals, ii, p. 123.

[4] It is proposed to designate the combined Nearctic (as restricted) and Palæarctic regions as the *Triarctic*, from the limitation of its fauna to the three continents bordering on the Arctic Sea. Under this acceptation the Nearctic, as hitherto recognized, completely disappears, and the Sonoran and Lower Californian subregions (to which must also be added parts of California, Texas, and Florida) of the former Nearctic become a portion of the Neotropical realm.

THE GENESIS OF THE CRYSTALLINE IRON-ORES.

BY ALEXIS A. JULIEN.

In an age which admits its special indebtedness for material advancement to the industries connected with the manufacture of iron, and in a country in which these industries have been so vastly developed as in this, the question of the origin of that metal has long possessed, and must always retain, a high degree of interest. So far as relates to the limonites, turgites and bog-ores, the question has met with a satisfactory answer in the theory of the concentration of these ores by the percolation of organic acids, as fully presented in the writings of Bischoff, Hunt and others; especially as the process can be actually observed and studied in progress in the lakes, marshes and bogs of the present day. But the mode of genesis of the crystalline ores—hematites, magnetites, menaccanites, and their mixtures—enveloped partly in the sedimentary strata and chiefly in the still more ancient crystalline rocks of archæan age, can be only inferred from analogies. Nor can the problem be considered as solved by any or all of the numerous theories which have so far been advanced. These theories may be naturally divided into two classes, as they may refer the iron-ores, enclosed in the subterranean strata, to an extraneous or to an indigenous origin.

A. Theories of Extraneous Origin.

To begin with the former, we have

1. *Meteoric fall.* This startling theory has been suggested to account for the enormous mass of martitic specular iron-ore, claimed to be the most extensive known single deposit of iron-ore on the continent, that of the Cerro de Mercado, two miles from Durango, Mexico. "Cerro de Mercado is a mountain, one mile long, one-third of a mile wide, and from 400 to 600 feet in height. The ore-surface of the mountain aggregates over 10,000,000 square feet; but there are indications that the ore is not all above ground, and the engineer's report declares it to be an enormous aërolite, half imbedded in the level plain on which it lies." Such a view is sufficiently controverted by the mineralogical constitution of

the mass, and its structure—"immense veins of specular iron-ore standing nearly vertical."[1]

2. *Eruption as dykes.* According to this genetic view, the crystalline iron-ores have been extruded from the interior in a pasty condition, like a lava, through fissures in the superficial strata.[2] This theory has been recently further developed in reference to the banded jaspery iron-ores of Michigan, and it has been advanced that the banding and lamination of these ores are similar in character and origin to those strongly marked in rhyolytes, furnace slags, etc.[3] The mineralogical constitution and infusibility of these ores, their distinctly sedimentary lamination, etc.,[4] clearly testify to the unsoundness of these hypotheses.

3. *Sublimation into fissures.* The inconsiderable crusts of specular oxide, which have been observed in the vicinity of volcanoes, such as Vesuvius, have certainly no relation to the enormous *bedded* masses, distributed throughout the world, at a distance from volcanic centres.

B. Theories of Indigenous Origin.

The theories of this class differ in ascribing the origin of iron-ores to either chemical or mechanical agencies. Nine chemical theories have been proposed.

4. *Concentration from ferriferous rocks or lean ores*, by the solution and removal of the predominant constituent, *e. g.*, silica,

of the relation of any of the crystalline iron-ores, enclosed in sediments of plainly submarine origin, with any such subaërial process. Even were the theory satisfactory in regard to the pure ores, the essential question remains unanswered, viz., the genesis of the original "ferriferous rocks or lean ores" themselves.

5. *Saturation of porous strata, e. g.*, of sandstone, by infiltrating solutions carrying iron oxide.[1] This theory, however applicable to certain rock-masses rich in hydrated ferric oxides, can account neither for the concentration of the huge and pure bodies of the true ores, nor for the alternation of siliceous and ferriferous laminæ and layers in the lean ores.

6. *Infiltration into subterranean chambers and channels*, depositing pipe-ores and limonites in widened crevices and joints of the more recent limestones or other sedimentary rocks, or in cavities overlying impervious strata.[2] The lenticular form, laminated structure, intercalation of the material of the matrix, enclosure of the ore-bodies in the bedding-planes, and other facts, markedly distinguish the crystalline ores from the limonites formed by such a process.

7. *Decomposition of pyrite*, and other ferruginous minerals, enclosed in decaying schists, and transfer of the iron-oxide in solution as ferrous sulphate.[3] The precipitation of the iron-oxide has been sometimes attributed to simple oxidation, more usually to the production of ferrous carbonate, by reaction between the ferrous sulphate and the calcium carbonate of the limestone, afterwards converted into limonite by oxidation and hydration.[4] This theory has had only local application, even to the limonites, and its connection with the crystalline ores is rendered improbable by the absence of associated limestones, or, if present, of evidences of their erosion, etc.

8. *Derivation from original deep-sea deposits* of hydrous ferric oxide, or of ferrous carbonate, dehydrated by subsequent heat, and deoxidized by hydrogen.[5] By a modification of this theory, the jasper-ores have been connected with the ferruginous and mangan-

[1] Emmons, Nat. Hist. N. Y., iv, 94.

[2] F. Prime, Jr., Am. Jour. Sci., 1875 (iii), ix, 433.

[3] T. S. Hunt, Nat. Ac. Sci., Nov., 1874.

[4] G. Bischoff, Chem. and Phys. Geol., i, 236; F. Prime, Jr., *loc. cit.*; W. B. Rogers, Geol. Penn., 1868, ii, Pt. ii, 722, 729.

[5] J. P. Lesley, The Iron Master's Guide, p. 374.

iferous nodules which have been dredged from the surface-layer of the deep-sea ooze of our present ocean-bottoms.[1] All the evidence so far gathered, however, shows no correspondence between the phenomena, the ferriferous contents of the ooze consisting of irregular crusts and nodules, never continuous nor interlaminated with silica. On the other hand, there is abundant evidence that the strata associated with the crystalline iron-ores are mostly shallow-water or shore-deposits, in large part conglomeritic.

9. *Deposit from springs*, by oxidation and precipitation from solutions of ferrous carbonate, on exposure to the air at their issue.[2] Such deposits, it is admitted, are local and limited, and the theory can have no bearing on the ordinary wide-spread crystalline ores.

10. *Alteration of diffused ferric oxide*, disseminated through sediments, into ferrous carbonate, in presence of vegetable matter, and its accumulation in particular layers by processes of filtration and segregation.[3] The vague processes thus invoked to account for the accumulation of ores are not accepted as satisfactory, even for the carbonates of the coal measures, lying in definite planes. Nor do the sheets and beds of crystalline ores usually show the irregular characteristics which may be attributed to processes of segregation.

11. *Metamorphism of ancient bog-ores.* The reference of the crystalline iron-ores to this origin has been thus stated by Dr.

[redacted]

Le Conte also states: "Therefore we conclude that both *now* and *always* iron-ore is, and has been, accumulated by organic agency."[1]

Prof. J. D. Dana remarks,[2] concerning the Upper Silurian deposits: "The beds of argillaceous iron-ore * * * could not have been formed in an open sea, for clayey iron deposits do not accumulate under such circumstances. They are proof of extensive marshes, and, therefore, of land near the sea-level. The fragments of crinoids and shells found in these beds are evidence that they were, in part at least, salt-water marshes, and that the tides sometimes reached them." In reference to the Laurentian deposits, he states: "Limestone strata occurred among the alternations, and argillaceous iron-ores, though vastly more extensive. * * * The argillaceous iron-ore has become the bright hematite or magnetite, and it is banded by, or alternates with, schist and quartz, etc., which were once accompanying clay- and sand-layers."

Dr. Kitchell long ago opposed the theory of the igneous or eruptive origin of the magnetic iron-ores of New Jersey, maintaining that they "were of sedimentary origin, and had been deposited just as the gneiss and crystalline limestone had."[3] With this view Prof. Cook coincides, in the following statement: "The magnetic iron-ores of this State have originated from chemical or mechanical deposits, just as our hematites and bog iron-ores do now."[4]

In opposition to this theory, in its reference to subaërial bogs or marshes, it must be considered that the enclosing and associated strata bear universal testimony, both in their contents and the form of their superficies, to their submarine mode of deposit. On the other hand, if the bog-ore theory were applicable to these ores, every ore-bed would imply a terrestrial plane for the reception of the subaërial bog deposit, *i. e.*, for every ore-lens a corresponding elevation above the sea-level and ensuing subsidence of the entire underlying stratum. On the contrary, no evidence has been shown in the archæan strata of any subaërial surface; all appear to be submarine sediments, and that still more ancient rocky terrane which formed the coast whose débris, poor in iron,

[1] J. Le Conte, Elements of Geology, 375.

[2] J. D. Dana, Manual of Geol., p. 231 and 155.

[3] W. Kitchell, Geol. Surv. N. J., 2d Rep., 1855, 155, 229, etc.; and 3d Rep., 1856.

[4] G. H. Cook, Geol. of N. J., 1363, 61.

was deposited or strewn over the ancient Laurentian sea, and upon whose surface bog-deposits may have rested, seems to have been entirely buried up beneath later sediments. Again, the strongly marked lenticular form and laminated structure of all deposits of crystalline iron-ores—and even of the numerous smaller lenses, parallel or overlapping, which make up the large deposits—are unmistakably characteristic of marine accumulation, Neptune's own royal stamp. A bog-ore deposit is almost always irregular in outline, concretionary and cavernous in structure, and commonly characterized by concentration in pockets and groups of isolated lumps. One can rarely fancy any traces of such peculiarities in the compact symmetrical lenses which make up ordinary deposits of magnetite.

The complete dehydration and partial deoxidation of the hydrated iron-oxide of a bog-ore, necessary for its conversion into a magnetite, must have produced an enormous contraction; but of this there is rarely any evidence, such as might be expected, in the disturbance of the lamination of the ore, and of the stratification of the surrounding rock.

It is of common occurrence that a bed of crystalline iron-ore overlies a bed of limestone, in immediate contact (*e. g.*, at the Baldwin-Forsyth mine, Hull, Canada); and yet the surface of the latter is perfectly plane, presenting no trace of the pitting and erosion[1] to which so soluble a material would have been subjected by the action of the organic acids supposed to have been concerned in the concentration of the ore in a bog.

Although graphite does often occur in intermixture with the crystalline ores, its general absence seems to prove that it cannot be chiefly derived from the organic matter (1 to 36 per cent.) contained in all limonites, but rather, it may be, from the algæ and marine plants sometimes finding their growth and entombment in the sands, even of iron-oxide, in shallow water. To the deoxidation produced in the decomposition of the remains of such plants, the content of sulphur in many iron-ores may be due.

12. *The metamorphism of ancient lake-deposits* of limonite passing into hematite, corresponding to the oolitic "fossil ore" of the Clinton group of the Upper Silurian, to the "mustard seed" ore described by Sjörmalm, which is deposited near the banks of

[1] B. Von Cotta, Ore Deposits, 249, 284.

the present Swedish lakes,[1] etc. This "Lake ore" theory[2] seems to be valid for a large number of huge deposits of the crystalline ores, and also satisfactorily accounts for the abundant presence of apatite in many ore-beds. It may be fittingly applied, therefore, in explanation of the phenomena seen in those deposits which contain a notable amount of calcium phosphate; most of those which consist of hematite, or of magnetite passing into or occasionally enclosing hematite, viz., in this country those of Cerro de Mercado, of Southern Utah, of Port Henry, N. Y., etc.; and the beds of magnetite which present the botryoidal and concretionary aspect and radiated structure of limonite, *e. g.*, in Southern Utah.[3]

On the other hand, the poverty or almost entire absence of phosphorus and sulphur in certain ore-beds, and the extreme abundance of titanic acid, free alumina, garnet, olivine, etc., in others, demand some other explanation.

Two mechanical theories are yet to be considered.

13. *Violent abrasion and transport.* This theory may be best stated in the words of its author:

"That the azoic period was one of long-continued and violent action cannot be doubted, and while the deposition of the stratified beds was going on, volcanic agencies, combined with powerful currents, may have abraded and swept away portions of the erupted, ferriferous masses, re-arranging their particles and depositing them again in the depressions of the strata."[4]

This theory of Whitney was supplementary to his main theory of volcanic eruption of the ferriferous masses, rich in native iron. But to this Lesley properly objects that such secondary deposits would be conglomeritic and also contain metallic iron.

14. *Concentration and metamorphism of iron-sands.* The work of the ocean as a grand abrading agent, and in the transport of the abraded detritus, has been largely studied and described by many authors; but less attention has been paid to the action which goes on, during the shorter or longer period of transport

[1] B. Von Cotta, Ore Deposits, 461; The Geologist, 1863, 36.

[2] Dr. J. S. Newberry, "The Genesis of Our Iron Ores," Sch. of Mines Quarterly, Nov., 1880, and "On the Genesis of Crystalline Iron-Ores," Trans. N. Y. Acad. Sci., vol. ii, Oct. 23, 1882.

[3] J. S. Newberry, *loc. cit.*, 12.

[4] J. D. Whitney, Met. Wealth of the U. S., 434.

of the detritus, in sorting out the various constituents in reference to specific gravity. Almost every sheltered bay and cove afford instances, not only of local deposits peculiar as to size, *e. g.*, gravels, sands, or fine silt, but concentrated gatherings of the grains of certain minerals, whose separation has been due to the relation of their specific gravity and form to the force of the surf or of local currents. The tertiary sands which border our Atlantic coast present everywhere examples of this continuous and delicate jigging action of the ocean, in the gathering together—now of black iron-sands, either magnetic or titaniferous, now of red garnet-sands, often of the two intermingled, and, still more abundantly, deposits of pure white quartz-sand. The iron-sands become very prominent in certain localities, *e. g.*, in this country at Killingsworth, on the Connecticut shore of Long Island Sound, on the north shore of the lower St. Lawrence, on the coasts of California and the shores of Lake Huron and Lake Erie, Oregon, etc., and abroad, along the coast of Great Britain, the shores of the Baltic and Mediterranean, New Zealand, Madagascar, and Hindostan. Special attention has been given to the deposits of the lower St. Lawrence, which lie about three metres above high-water mark, and comprise layers of black iron-sand, often nearly pure, from 1·5 to 15 centimetres in thickness.

"An inspection of the iron-sands, from the various localities above mentioned, shows that they all contain, besides the ores of [redacted]

he Sandwich Islands), hornblende, augite, volcanic glass, etc. he Mediterranean), often constitute the sands along the shores. h-sands, where non-calcareous, consist chiefly of the following rals,[1] which are arranged in the order of their specific gravities:

	S. G.
Quartz (and chert),	2·5—2·8
Olivine,	3·3—3·5
Garnet,	3·1—4·3
Chromite,	4·3—4·6
Menaccanite,	4·5—5·
Magnetite,	5· —5·1

is a significant fact that in the metamorphic, crystalline rocks ur continent, from Canada to Alabama, we find the same rals concentrated also in rock-form, viz.:

Quartzite (siliceous schist, jasper, etc.): common everywhere.

Chrysolite (or dunite. Largely converted into serpentine, etc.): Canada, Michigan, North Carolina, Georgia, Alabama, etc.

Garnetite (or garnet-rock. Sometimes made up of manganese-garnet): Canada, New York, North Carolina, etc.; in close association with magnetite at Franklin and near Andover, N. J., in Grenville, Canada, etc. Doubtless in some cases the origin of this mineral (as well as of olivine), especially if crystallized, must be assigned to indigenous development in the course of metamorphism. But, at the Buckhorn Mine, Harnett County, N. C., my own examination of the section, 61 metres in height, confirms the statement of Prof. Kerr,[2] who notes the following series (from above downward):

Specular ore (11 metres).
Manganesian ore.
Slaty manganese-garnet.
Feldspathic gneiss.
Manganese-garnet.
Gneiss.

n regard to pyrite, its ready decomposition has usually prevented its entration in sands. As to hematite, its foliated texture seems to have ted both in its wide transport and distribution, resisting concentration, in its after conversion into hydrated peroxide.

Geol. N. C., 1875, i, 222.

Here the garnet certainly occurs in ancient sedimentary layers, whose partial decomposition has saturated the ore with manganese oxide; while the small admixture of magnetite, frequently dispersed through the hematite, points to the original sediment of iron-sand.

Chromite: Massachusetts, Pennsylvania, North Carolina, etc.

Menaccanite: Canada, New York, New Jersey, Pennsylvania, etc.

Magnetite: common everywhere.

Compound varieties also occur in abundance, which correspond closely to the mixtures of the same minerals in the sands along the coast, viz.:

Magnetic quartzite (martitic and hematitic jasper-schists, etc.): common everywhere.

Magnetitic garnetite (also hematitic and *manganesian*): Buckhorn Mine, N. C.

Chromitic dunite: Canada, North Carolina, Alabama, etc.

Chrysolitic menaccanite (with magnetite): Cumberland, R. I.[1]

Chrysolitic magnetite: O'Neil Mine, Monroe, Orange County, N. Y.[2]

Garnetiferous magnetite: mines in Saratoga and Washington Counties, N. Y., etc.

Similar allied rocks occur abundantly in foreign countries: dunite and chrysolitic rocks in Europe, New Zealand, etc.; chrysolitic magnetite, at Taberg, Sweden;[3] magnetite and menaccanite, in many localities.

Garnet, together with hornblende, augite, cassiterite, apatite, etc., has been observed in admixture with the magnetites of many foreign deposits, *e. g.*, of the Thorbjörnsbo mine at Arendal, Sweden; of Traversella, in Piedmont; of Berggieshübel, in Saxony; of Schmiedeberg, in Silesia, etc. F. Wöhler relates:

"We spent a day in the large iron-mines of Langbanshytta. The gangue of the fine magnetic iron-ore is frequently brown

[1] M. E. Wadsworth, Bull. Mus. Comp. Zool., 1881, vii, 183.

[2] J. D. Dana, Am. Jour. Sci , 1881 (iii), xxii, 152.

[3] A. Sjören, Neues Jahrb. für Min., 1876, 434.

garnet, which is found in large quantities at the mouth of the mine, and often serves as flux for the reduction of the ore."[1]

As the rock-strata, associated with all these varieties, are undoubtedly of marine origin, and indicate deposition in shallow water, it is natural to infer their correspondence in origin, in many cases, with the unconsolidated shore-deposits of the present day. In a recent search through the scientific literature of the subject for any similar view, the following statement was found concerning the crystalline iron-ores of Canada, in which this theory has been, with some reserve, associated with the bog-ore theory:

"It seems possible that, in some cases, beds may have been formed by the accumulation of iron-sands, just as they are forming in the Gulf of St. Lawrence to-day, the material being derived from the disintegration of pre-existing crystalline rocks. Such beds we should expect to contain, not only magnetite, but ilmenite, and it is well known that in many cases, ores, on being pulverized, may be more or less completely separated into a magnetic portion, containing little or no titanic acid, and a non-magnetic portion consisting essentially of ilmenite. It seems, however, probable that in general their origin has been similar to that of the modern bog- and lake-ores. Deposits of magnetite, as a rule, do not continue of uniform thickness for any great distance like the enclosing rocks; and this is just what might be expected if we suppose them to have originally occurred as bog- or lake-ores, which accumulated in local hollows or depressions."[2]

The thinly laminated martitic and hematitic jasper-schists of the Huronian age, always remarkably free from both sulphur and calcium-phosphate, at once present themselves for explanation. Prof. Dana, in a criticism on other views,[3] has attributed the origin of these iron-ores to "metamorphism from original marsh-made beds." More probably, in my opinion, the conditions consisted of a shore of some quartzose rock, rich in magnetite, whose débris the waves and currents strewed over the sea-bottom, alternately with thin sheets of quartz-granules and magnetite-crystals, partially concentrating the one or the other material in numerous heaps or thicker layers. In the progress of the metamorphism and contortion

[1] F. Wöhler, Early Recollections of a Chemist, Am. Chem., 1875, vi, 131.

[2] B. J. Harrington, Geol. Surv. Canada, Rep. Prog., 1873-1874, 195.

[3] Am. Jour Sci., 1881 (iii), xxii, 402.

to which the layers were subjected, their compact and lenticular forms were further developed, the magnetic oxide was further oxidized, partially as martite, or completely as specular ore (as already suggested by Brooks, Credner, and others), and assumed, at points where the contortion and pressure became intense, the micaceous structure and brilliant lustre of micaceous iron-ore, by a process similar to that which produces "slickensides."

The concentration of nearly pure magnetite in the deposits enclosed in the Lower Laurentian strata of Canada and the Adirondacks, and of titaniferous magnetite or menaccanite in the huge ore-beds associated with the anorthosites of the Upper Laurentian in both regions, point unmistakably to mechanical separation of ferriferous sediments from different terranes: *i. e.*, in the one case from the magnetitic gneiss, in the other from the traps and anorthosites, rich in menaccanite. An examination of thin sections of diabase from dykes cutting pure magnetites in Essex County, N. Y., showed this rock to be rich in menaccanite and a possible source of such sediments.

No concentration of titanic acid has ever been found in limonites or bog-ores. These facts seem significant of the insufficiency of any chemical theory to account for the origin of all the iron-ores.

In conclusion, it may be inferred that the mode of genesis of a bed of magnetic iron-ore may be determined with some probability by the following diagnosis.

When the ore retains structural characteristics allied to those of limonite, or encloses masses of hematite, or contains a notable amount of calcium-phosphate, a chemico-organic origin is probably indicated.

When the ore is exceptionally free from phosphorus, or is rich in titanic or chromic acid, or is closely associated or mixed with granular garnet or olivine, a mechanical origin may be inferred

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending Nov. 30, 1882, fifteen members and six correspondents have been elected.

The Council has endeavored to recommend for election as correspondent those only who deserve such recognition of their scientific standing, or who, as collectors and contributors, may confer material benefit on the society.

Resignations of membership have been received from Ferris W. Price, T. L. Buckingham, T. Miles, H. W. Stelwagon and Henry Leffman. The name of one member-elect was ordered to be stricken from the roll in consequence of the provisions of the By-Laws not having been complied with within the prescribed time.

The deaths of twenty-one members and eleven correspondents have been announced. The names of the deceased have been recorded in the printed Proceedings, under the several dates of announcement.

Twenty-two papers have been presented for publication, as follows: Angelo Heilprin, 3; Rev. Dr. H. C. McCook, 2; Theodore D. Rand, 2; Henry S. Williams, 1; Dr. W. S. W. Ruschenberger, 1; L. T. Day, 1; Aubrey H. Smith, 1; Rafael Arango, 1; Dr. Harrison Allen, 1; J. S. Newberry, 1; Charles Mohr, 1; T. W. Eastlake, 1; R. E. C. Stearns, 1; Dr. Joseph Leidy, 1; Drs. H. C. Wood and H. F. Formad, 1; Joseph Swain, 1; H. A. Keller, 1; E. S. Reinhold, 1. These include four papers which were presented through the Mineralogical Section and published as part of its Proceedings. The paper by Drs. Wood and Formad, on Diphtheria, was withdrawn by the authors; all the others have been printed.

One hundred and fifty-two pages of the Proceedings for 1881, and two hundred and forty-eight for 1882, together with six lithographic plates, have been published.

Some of the earlier numbers of the publications having been entirely exhausted, it was found necessary to reprint 75 pages and three plates of the quarto Journal and 38 pages of the Proceedings. The Publication Committee is greatly indebted to Mr. Chas. F. Parker, who has devoted much care to the arrange-

ment of our stock of the earlier publications. Apart from frequent errors of paging and numbering of signatures, no account had been taken of stock on hand since the removal of the society to the present building, and it required one of Mr. Parker's experience in such work to determine how far sets of the first ten volumes of the Proceedings could be completed. The result has been an unusually large return from sales of back numbers and complete sets, as may be seen by reference to the report of the Treasurer. It will, however, require considerable additional outlay for reprinting, to enable the Committee to fill orders for the first series of the Proceedings. The scarcer numbers and volumes have not, of course, been sold separately.

One hundred and twenty-five copies of the Proceedings have been distributed to subscribers, and three hundred and forty to foreign and domestic exchanges. Of the latter, seventy-six have been sent by mail, and two hundred and sixty-four have been distributed by the Smithsonian Institution and its system of international agencies.

The average attendance at the weekly meetings, which have been held without interruption, has been twenty-six. Verbal communications have been made by thirty-two individuals, and the majority of them have been published in the Proceedings. So well has the interest in these meetings been sustained, that it has been found desirable to report forty-three of them, or all but nine, and these for the most part held in midsummer, for the public papers. In addition to the regular meetings of the Academy, those of the Sections have been held with the results recorded in the several reports.

The By-Laws were amended as follows :—Art. 14, Chap. V, by striking out all after the word "meetings," in the third line, and inserting "and with like approval may change the same." Art. 4, Chap. V, by adding "But Sections may admit persons not members of the Academy to be contributors under such rules and on such terms as the Section may determine, always provided, that a contributor shall not be eligible to office in a Section, or to vote on any question; and also provided that the rights and privileges of a contributor shall be restricted to attendance at the meetings of the Section, to the reading of original scientific papers and to taking part in the scientific discussions and proceedings exclusively, and that a contributor shall have no other right or privilege whatever in the Academy."

A proposition to so amend Art. 1, Chapter XI, as to prevent the loaning of type specimens from the Museum, was, on the recommendation of the Council, lost, it being the opinion of the majority that sufficient guarantee for their care and preservation already existed in the laws governing the loaning of specimens.

On April 25, Dr. Chas. Schaeffer was elected a Curator to supply the vacancy caused by the death of Dr. Kenderdine. He held the position until Oct. 31, when he resigned in consequence of a proposed continued absence from the country. As the vacancy occurred so near the end of the year, it was not deemed necessary to fill it until the casting of the annual ballot, which resulted in the election of Dr. W. S. W. Ruschenberger, together with the three Curators who had held office during the year.

The death of Mr. Wm. S. Vaux left vacant a Vice-Presidency and a Curatorship. On May 23 the Rev. Dr. Henry C. McCook was elected to the former office and Mr. Jacob Binder to the latter. Mr. Thos. A. Robinson was elected to fill the vacancy in the Council, caused by the election of Rev. Dr. McCook as Vice-President, he thereby becoming an ex-officio member of the Council.

At the meeting held May 23 a letter was read from a friend of the Academy, presenting through Mr. Jos. Jeanes the sum of one thousand dollars, to be appropriated in such manner as Mr. Jeanes might think best for the interests of the society. It having been suggested by Mr. Jeanes that the money might with advantage be made the nucleus of a Museum Fund, this disposition of the gift was ordered, and the meeting held May 30, adopted the following resolutions, placing the creation of the Fund on formal record:—

Inasmuch as the Academy has determined to appropriate towards the creation of a Museum Fund, one thousand dollars which have been received from "a friend of the Academy," whose name is withheld at his request, through the kindly hands of Mr. Jeanes:—

Resolved, That the Museum Fund thus begun be held under the provisions of the By-laws, Chap. VI, like other special funds.

That Mr. Jeanes be requested to convey to our liberal friend the thanks of the Academy for his bounty and generous token of friendliness to scientific work.

The Museum of the Academy, in some respects one of the

finest in the world, has grown almost entirely by gifts from those interested in the progress of the natural sciences. The Curators have never until now had even the smallest annual sum placed at their disposal for the purchase of desiderata, and many opportunities, therefore, of obtaining such have been lost. Several of the departments of the Museum are now so large that a comparatively small outlay will be sufficient to keep them abreast of current investigation. The value of a museum depends, not so much upon its size as upon the care taken by competent persons in the selection of the objects composing it.

Thanks to the liberality of Mr. Isaiah V. Williamson, Mr. Jos. Jeanes and the late Dr. Thomas B. Wilson, the Academy is reasonably well supplied with current scientific literature, but such fresh collections as have been studied from time to time by those connected with the society, either as members or students, have been for the most part secured by individual enterprise. It is hoped that the Museum Fund now created will be so added to as to furnish the means of procuring for the society material for original research.

At the meeting held Sept. 12, a committee, consisting of Messrs. Ruschenberger, Redfield, Tryon, McCook and Meehan, was appointed for the purpose of determining means for the extension of the building.

In harmony with a suggestion made by Dr. Horatio C. Wood, during a communication to the Academy, Oct. 10, on the source of supply of the cinchona alkaloids, a committee, consisting of Messrs. H. C. Wood, Thos. Meehan, John K. Valentine, Isaac C. Martindale and John H. Redfield, was appointed to memorialize Congress as to the importance of making suitable experiment in the cultivation of Cuprea bark within the limits of the United States.

No reports from these committees have as yet been received.

All of which is respectfully submitted,

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

In accordance with the laws of the Academy, the Corresponding Secretary submits the following report for the year ending Nov. 30, 1882.

The business for the year has consisted, for the most part, of letters from corresponding societies transmitting their publications and acknowledging the receipt of those sent by us, as well as acknowledgments from newly elected Correspondents.

The correspondence from the Academy has been the official acknowledgments and thanks of the society for donations of various kinds to the Museum, and the notification of Correspondents of their election.

In addition there is always an amount of miscellaneous correspondence, the greater part of which has been brought before the Academy for its action when needed; otherwise the letters, usually of inquiry, have been promptly answered.

During the summer the Corresponding Secretary had the opportunity of visiting the libraries of many corresponding societies, and found the exchanges in good state of completeness and as promptly received as is usual through the international exchange. Deficiencies were, however, detected in some instances and requests have since been officially received for missing parts.

During my absence the duties of the position were kindly and ably performed by Prof. Angelo Heilprin.

The summary is as follows:—

LETTERS RECEIVED.	
Acknowledgments from Corresponding Societies,	46
Letters of transmission of publications,	50
Acknowledgments of election,	7
Miscellaneous,	17
LETTERS SENT.	
Acknowledgments of donations to Museum,	165
Notifications of Correspondents elected,	6
Miscellaneous,	12

The donations to the Museum have been acknowledged in full to the donors, the number above indicating merely the letters sent; a more detailed account will appear in the Curators' report.

Respectfully submitted,

GEORGE H. HORN, M. D.,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The Librarian reports that during the year ending Nov. 1882, there have been 2795 additions made to the library of t Academy. This increase has been composed of 366 volum 2417 pamphlets and parts of periodicals, and 12 maps. The lar number consists as heretofore of instalments of journals a transactions received in exchange for the publications of t Academy from corresponding societies.

The sources from which this increase has been derived is follows:—

Societies,	1058
Editors,	769
I. V. Williamson Fund,	291
Authors,	230
F. V. Hayden,	158
Jos. Jeanes,	61
Wilson Fund,	50
Geo. Vaux,	41
Department of the Interior,	21
Department of Agriculture,	13
Geological Surv. of Belgium,	13
Executors of the late Dr. Robert Bridges,	12
Geological Survey of India,	10
Engineer Department, U.S.A.	8
Isaac Lea,	8
Minister of Public Works, France,	6
Treasury Department,	5
War Department,	4
British Museum,	3
Smithsonian Institution,	3
Minister of Public Works, Mexico,	3
Geological Survey of New Jersey,	2
Geological Survey of Canada,	2
Norwegian Government,	2
Trustees of Public Library, Victoria,	
Health Department, N. York,	
Rev. Dr. Syle,	
Liverpool Free Public Library,	
Geodetic Commission of the Netherlands,	
Fish Commissioners of Connecticut,	
J. A. Ryder,	
Geol. Survey of Minnesota,	
B. Westermann & Co.,	
Department of Mines, Nova Scotia.	
Department of Mines, N.S.W.	
Asa Gray,	
U. S. Coast Survey,	
Louisiana Board of Health,	
Rev. H. C. McCook,	
Geological Survey of Pennsylvania,	
Thomas Meehan,	
Trustees of City Hospital, Boston,	
G. W. Fox,	
Mayor of Brighton,	
Australian Museum, Sydney,	
Royal College of Surgeons,	

The books and pamphlets obtained from these sources w distributed to the various departments of the library as follows:

Journals,	2124
Geology,	185
General Natural History,	69
Conchology,	62
Mineralogy,	60
Entomology,	58
Botany,	
Bibliography,	
Chemistry,	
Anthropology,	
Ornithology,	
Agriculture,	

Physical Science,	12	Herpetology,	6
Voyages and Travels,	10	Encyclopedias,	5
Helminthology,	9	Education,	4
Ichthyology,	9	Geography,	3
Medicine,	8	Languages,	1
Mammalogy,	8	Miscellaneous,	18
Anatomy and Physiology,	8		

The income of the I.V. Williamson Fund has been mainly devoted during the past year to the purchase of continuations of books already subscribed for, and to the paying of bills which had accumulated in consequence of the failure of some of the ground-rents from which the fund is derived, as noticed in my last annual report. These bills have now all been paid and the entire income of the fund for the coming year will be at the disposal of the committee. With the exception of Elliott's Felidæ and Bucerotidæ, but little has been obtained from the income of the Wilson Fund, except the continuations of works subscribed for by the late Dr. Thos. B. Wilson.

The more valuable books in addition to those received from the above funds and in exchange, have been the gift of Mr. Jos. Jeanes, who, in addition to the $739.80 recorded in my last report, as having been given by him for the purchase of geological and botanical books, has placed during the past year $300 at the disposal of the Library Committee for the purchase of such miscellaneous works as were immediately desirable. The titles of works thus obtained, as well as those of all others received during the year, will be found in the appended list of additions to the library.

The Academy is also indebted to Mr. Jeanes for a gift of $300 to be used in binding journals, etc., subscribed for from the I. V. Williamson Fund.

At a meeting of the Academy held April 26, 1882, it was resolved, in accordance with the recommendation of the Council, to authorize the Library Committee to accept the proposition which had been received from Mr. Geo. W. Tryon, Jr., under date of Jan. 16, to dispose by sale of certain works in the library, which were in no sense connected with natural history, together with the duplicates which had been accumulating for years. The proposition to select, catalogue and sell these books under the supervision of the Library Committee was made on condition that one-half the net proceeds, after paying expenses, should be transferred to the Academy, and the other half to the Conchological

Section to form the nucleus of a fund for the purchase of specimens for the Museum.

The sale was authorized under the conviction that many valuable books on the Fine Arts and general literature would be of more use in collections where they would be inquired for and consulted than if they were retained as part of the library of the Academy, from the specialty of which they were so distinct. Such a disposition of these books and the accumulated duplicates as would be of greatest benefit to the library of the Academy would certainly meet with the approval of their liberal donors, chief among whom were Wm. Maclure and Dr. Thomas B. Wilson.

About 1897 volumes were thus disposed of; 1272 were works on religion, history, politics and general literature, for the most part of little interest or value; 424 were duplicates and 201 were on the fine arts, architecture, antiquities, etc. Care was taken to retain everything which could be considered as even remotely pertaining to natural history.

The proceeds of the sale amounted to $1325.14, the Academy's share of which, $662.57, was appropriated for binding. Each volume thus bound has a label placed on the inside of the cover properly crediting the fund. This amount, in addition to the sum received from Mr. Jeanes, has enabled me to have bound during the year 677 volumes, while 240 are in process of binding. It is believed that a sufficient balance will remain to provide for the binding of [redacted]

subscription a portrait of Dr. Bridges, which, it is hoped, will be hung in place early in the year. A framed life-sized crayon portrait of Prof. John Tyndall was presented by the artist, Mr. Ross.

In view of the above statements the Academy may be congratulated on the fact that the past year has been an unusually prosperous one for the library.

All of which is respectfully submitted,

EDW. J. NOLAN,

Librarian.

REPORT OF THE CURATORS.

The Curators present the following from the Curator-in-charge as their report for the year ending November 30, 1882:—

I would respectfully report, that during the year Mr. C. H. Townsend has been engaged in separating the families of Passerine birds, from the general ornithological collection, preparatory to a better arrangement of that order.

Mr. G. Howard Parker has been engaged in the arrangement of the Coleoptera.

The various collections have been carefully examined, and are in good condition.

The specimens presented to the Museum during the year have been labeled, and placed in their proper places.

Some progress has been made in labeling and arranging of specimens in the Museum.

Respectfully,

C. F. PARKER.

SUMMARY OF THE REPORT OF WM. C. HENSZEY, TREASURER, FOR THE YEAR ENDING NOV. 30, 1882.

DR.

To Balance from last account		$ 918 71	
" Initiation fees		140 00	
" Contributions (semi-annual contributions)		1927 51	
" Life Memberships		200 00	
" Admissions to Museum		458 60	
" Sale of Guide to Museum		45 00	
" Sale of duplicate books	$ 5 00	667 57	
" One-half proceeds of sale of books	662 57		
" Sale of paper		1 05	
" Freight returned		13 75	
" Fees, Lectures on Palæontology		168 00	
" " " " Mineralogy		28 00	
" Publication Committee		1362 57	
" Interest from Mortgage Investments, Joshua T. Jeanes' Legacy		1000 00	
" Wilson Fund toward Salary of Librarian		300 00	
" By Publication Fund. Interest on Investments		508 55	
" Barton Fund. " " "		480 00	
" Life Membership Fund. " " "		100 00	
" Maintenance Fund. " " "		50 00	
" Eckfeldt Fund. " " "		69 79	
" Interest on Deposits		51 10	
			$8490 2

CR.

Salaries, Janitors, etc		$3204 96	
Freight		38 21	
Repairs		352 93	
Insurance		30 00	
Coal		418 00	
Gas		134 85	
Mounting Bird		1 50	
Printing, Stationery and Postage Stamps		126 77	
Alcohol		2 80	
Newspaper reports		92 00	
Water Rent		26 15	
Trays		49 00	
Printing and Paper	$1275 28	1305 28	
Binding same	30 00		
Plates and Engravings		197 00	
Binding		429 75	
Six Cases of Drawers		136 50	
Guides to Museum		23 00	
Books		44 15	
Trubner & Co., London		59 96	
A. Heilprin, fees from Lectures on Palæontology		168 00	
H. C. Lewis, fees from Lectures on Mineralogy		28 00	
Life Memberships, transferred to Life Membership Fund,		200 00	
Transferred to Stott Legacy Fund		2 00	
Miscellaneous		428 58	
			$7498 8
Balance, General Account			$991 3

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement	$1100 00
Life Memberships transferred to this account	200 00
Interest on Investments	100 00
	$1400 00
Transferred to General Account	100 00
To Balance for Investment	$1300 00

BARTON FUND. (For Printing and Illustrating Publications.)

Balance per last Statement	$240 00
Interest on Investments	240 00
	$480 00
Transferred to General Account	480 00

JESSUP FUND. (For Support of Students.)

Balance per last Statement	$581 67
Interest on Investments	560 00
	$1141 67
Disbursed	430 00
Balance	$711 67

PUBLICATION FUND.

Balance per last Statement	$1408 25
Income from Investments	290 00
I. C. Martindale. Life Subscription to Proceedings	25 00
	$1723 25
Transferred to General Account	508 55
To Balance for Investment	$1214 70

MAINTENANCE FUND.

Balance per last Statement		$ 626 35
Interest on Investments		50 00
Isaac C. Martindale		6 79
Joseph Wharton		1000 00
Susan W. Logan and A. Sydney Logan, Executors J. Dickinson Logan, deceased	$500 00	
Less Collateral Inheritance Tax	25 00	
		475 00
		$2158 14
Transferred to General Account		50 00
To Balance for Investment		$2108 14

Mrs. STOTT FUND. (For Publications.)

Balance per last Statement for Investment		$2000 00
Transferred from General Account		2 00
		$2002 00
By Balance	$ 2 00	
Investment in Bond and Mortgage, 5 per cent. Interest	700 00	
		702 00
To Balance for Investment		$1300 00

ECKFELDT FUND.

Balance per last Statement for Investment	$966 86
Interest on Investments	69 79
	$1036 65
Transferred to General Account	69 79
To Balance for Investment	$966 86

I. V. WILLIAMSON LIBRARY FUND.

Balance per last Statement		$41 46
Rents collected		771 50
Ground-rents collected		1197 99
		$2010 95
For Books	$1040 81	
Subscription to Journal	3 00	
Binding	4 45	
Taxes and Repairs to Properties	429 17	
Collecting	100 54	
		1577 47
Balance		$433 48

THOMAS B. WILSON LIBRARY FUND.

Balance overdrawn as per last Statement	$113 38
For Books	340 61
For Binding	3 90
Transferred to General Account toward Salary of Librarian	300 00
	$757 89
Interest on Investments	525 00
Balance Overdrawn	$232 89

MUSEUM FUND.

Donation from Unknown Friend, per Joseph Jeanes, Esq., for Investment	$1000 00

BOOK FUND.

Balance per last Statement	$525 80
Joseph Jeanes. Donation	300 00
Thomas Meehan. For Books	12 69
	$838 49
Less cash paid for Books	498 66
Balance	$339 83

INSTRUCTION FUND.

Balance per last Statement	$35 00
Isaac C. Martindale	1 30
Frederick Gutekunst	10 00
John T. Morris	50 00
	$96 30
Less cash disbursed for purposes appertaining to the Fund	36 30
Balance	$60 00

BINDING FUND. (Donations from Joseph Jeanes, Esq.)

Joseph Jeanes. Donations	$300 00
Less cash disbursed for Binding	22 15
Balance	$277 85

REPORT OF BIOLOGICAL AND MICROSCOPICAL SECTION.

Eighteen meetings were held during the year, with an average attendance of about fifteen members.

The following were elected members:—Dr. Crozier Griffith, Dr. George A. Rex, Edward P. Starr, Wilson Mitchell.

The following became contributors:—Dr. McClurg, J. H. Fenton, Dr. R. A. Rainear, J. F. Herbert, D. S. Newhall.

The following resigned membership:—J. E. Mitchell, Dr. R. J. Levis, Dr. Guilford, Dr. Charles Turnbull.

The following members have died:—Dr. George Dixon, Dr. Robert S. Kenderdine, William S. Vaux.

During the year many valuable communications were brought before the Section, and interesting discussions kept up the usual attendance of members and visitors. Among the more valuable communications, etc., may be mentioned those by the following gentlemen:—

Mr. D. S. Holman.—An exhibition of a Projecting Microscope of peculiar design.

Dr. L. Brewer Hall.—An Eye Protector, to be used upon the draw tube of the microscope.

Mr. Balen.—An exhibition of living objects, especially specimens of *Philodina*, *Pandorina*, etc.

Mr. Mitchell McAllister.—A lecture upon the Cultivation of Hyacinths.

Mr. John Ryder.—Upon the Embryology of Fishes. Also upon a Compressorium of special design for study of the above.

Mr. George Binder.—Extended observations upon the *Anthe-renis.*

Mr. J. Schimmel.—Extended observations upon the *Chilodon cucullulus.*

Dr. G. A. Rex.—Lecture upon the Classification of the Myxomycetes.

Mr. Edward Potts.—Lecture upon Fresh-water Sponges, and their Classification.

Mr. Jacob Binder.—Extended observations upon the Sucking Cups upon the fresh-water beetles.

Dr. J. G. Hunt.—Upon Reproduction in the Algæ. Also upon Special Methods of Preparation and Mounting of Microscopical Objects.

Dr. Crozier Griffith.—Upon the Minute Anatomy of the Kidney, and upon the Vasa Recta Vessels of the Testicle.

Mr. Charles Perot.—Upon the Development of *Attacus.*

Dr. Alfred Reed.—Upon Vaccine Virus.

Mr. John C. Wilson.—Upon *Collomia coccinea.*

On October 16, the Mineralogical Section of the Academy, by invitation, met with this Section in the consideration of objects of interest to both.

At the Annual Meeting held the first Monday in December, the following were elected officers to serve during the year:—

Director, ...	Mr. Jacob Binder.
Vice-Director, ...	Mr. John C. Wilson.
Recorder, ...	Dr. Robert J. Hess.
Corresponding Secretary, . .	Dr. L. Ashley Faught.
Treasurer, ...	Dr. Isaac Norris, Jr.
Conservator, ...	Mr. Charles P. Perot.

Respectfully,

ROBERT J. HESS,

Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that papers by Prof. Angelo Heilprin, Rafael Arango, T. W. Eastlake and R. E. C. Stearns have been published in the Academy's Proceedings.

Since last report, two members, Wm. S. Vaux and Chas. M. Wheatley, and one correspondent, Dr. F. H. Troschel, have died.

Mr. Vaux became a member December 6, 1867, and was a frequent and liberal contributor to our Museum.

Mr. Wheatley was elected January 3, 1867. He for many years studied the Fresh-water Mollusks, and contributed freely both to our Museum and publications.

Dr. Troschel was elected a correspondent August 1, 1867. His death leaves incomplete his great work upon the Dentition of the Mollusca. Besides being the author of numerous other papers, principally upon the Anatomy of Mollusks, Dr. Troschel had for years annually reviewed the literature of Conchology for Wiegmann's "Archiv für Naturgeschichte." His death is a loss to science, especially in his own department.

Mr. Geo. W. Tryon, Jr., Conservator, reports that:—

"During the year ending December 1, 1882, fifty-two donations of recent shells and mollusks have been received, aggregating 2049 specimens of 724 species. Assisted as usual by Mr. Chas. F. Parker, these additions have all been labeled, mounted and arranged in the general collection, which now numbers 40,225 named tablets, upon which are mounted 141,641 specimens. A detailed list of the accessions for the year is annexed to this report. The most important of these are: A collection of 221 species, all new to the Museum, purchased by the Section; 61 species of Californian marine shells, including a number of rare and fine specimens, presented by Joseph Jeanes; 123 species of Tasmanian marine shells, nearly all new to our collection, presented by C. E. Beddome, of Hobart Town, Tasmania. To our generous Australian correspondents, Dr. J. C. Cox and Mr. John Brazier, we are again indebted for valuable suites of their native shells.

"The rearrangement of the Conchological Museum, commenced four years ago, is progressing. During the year, the Marginellidæ and Olividæ have been revised and largely relabeled. Some idea

of the extent and completeness of our collection may be formed from the fact that in these two families alone it includes 946 trays. The Columbellidæ and Cypræadæ are now undergoing like revision, the latter by Mr. S. R. Roberts."

There have been no changes made in the By-Laws of the Section.

The officers of the Section for 1883 are:—

Director, ...	W. S. W. Ruschenberger.
Vice-Director, . . .	John Ford.
Recorder, ...	S. Raymond Roberts.
Secretary, ...	John H. Redfield.
Librarian, ...	Edw. J. Nolan.
Conservator, . . .	Geo. W. Tryon, Jr.
Treasurer, ...	Wm. L. Mactier.

Respectfully submitted, on behalf of the Conchological Section, by

S. RAYMOND ROBERTS,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section takes great pride in reporting, that notwithstanding the agreeable reports he has had to make in former years, he believes the prosperity of the work of the Section has been greater during this than any former one. Meetings have been held in all but the two summer months, and many valuable facts communicated, some of which have been repeated before the general meetings of the Academy, and published in its Proceedings. There are no debts of any consequence against the Section, while its Treasurer reports a balance on hand of $119.92. During the year one member has resigned, and it has lost one by death. The officers elected for the ensuing year are as follows:—

Director, . . .	Dr. W. S. W. Ruschenberger.
Vice-Director, . .	Thomas Meehan.
Recorder, . . .	F. Lamson Scribner.
Cor. Secretary, *Treasurer*, } . .	Isaac C. Martindale.
Conservator, . . .	J. H. Redfield.

It seems almost superfluous to repeat what has been so often said before in these reports, that the voluntary work of the mem-

bers is not equal to the task of placing the magnificent Herbarium of the Academy on the footing it is worthy of occupying, unless some competent botanist could be employed within a reasonable time. Still in the hope that the Academy may soon see its way to aid them, the members continue to do what they can; and the Section has very great pleasure in adopting the report of its Conservator, as part of its report of the work of the year.

Respectfully submitted,

THOMAS MEEHAN,
Vice-Director.

Conservator's Report.—The additions to the Herbarium of the Academy during the past year, exceed those of any year since the organization of the Section, being estimated at 3346 species, of which more than one-third were new to the collection, and adding more than 100 genera not before represented.

For a large proportion of these we are indebted to the zeal and liberality of our own members, who have evinced a laudable desire to perfect the Academy's collection, by filling its desiderata, and by improving the character of the representation of species already possessed. Special thanks are due to Messrs. Canby, Parker, Martindale, Meehan and others, for their efforts in this direction.

But we have also been favored with most liberal donations from other sources. From Dr. Gray, of the Cambridge Herbarium, we have received more than 1000 species. Among them we may specify a second collection of plants made in the Kuram Valley, Afghanistan, in 1880, by Major J. E. T. Aitcheson, and valuable accessions from China, Formosa, Japan, Australia and Tasmania; also a fine series of the polypetalous plants of our Mexican border, collected by Schaffner, Havard, Palmer and others, which, supplementing a collection of Palmer's plants from one of our own members, give us a very full representation of the plants of the Texo-Mexican region.

Baron F. von Müller, of Melbourne, Australia, has sent us, through Mr. Meehan, 284 species of Australian plants, many of them desiderata, and from Prof. Sargent, of the U. S. Forestry Commission, we have received choice herbarium specimens of some of the rarer trees and shrubs of our western regions. A more complete list of the donations for the year will be appended.

The care and labor incident to the reception of these additions have been great, and though the Conservator has received most essential assistance from Messrs. Parker, Burk, Meehan and Scribner, he has had little time left to devote to the improvement of the condition of the herbarium. Yet something has been done in this way. Provisional lists of species in the general herbarium have been completed nearly to the end of the polypetalous orders. In the North American Herbarium, the orders Ranunculaceæ, Saxifragaceæ, and a few smaller orders have been mounted by the aid of Mr. Parker, who has also contributed liberally to the filling of gaps in these orders, for this purpose placing his own collection entirely at the disposal of the Conservator.

Respectfully submitted,

JOHN H. REDFIELD,
Conservator.

REPORT OF MINERALOGICAL AND GEOLOGICAL SECTION.

The Director of the Mineralogical and Geological Section would respectfully report :—

Meetings of the Section have been held regularly through the year, with a fair attendance, but the papers read have not been as numerous as in former years. The additions to the Collection have been satisfactory.

On the evening of October 15th, by request of the members of the Microscopical and Biological Section, our Section met with them, the subject under consideration being Microscopic Mineralogy. By the courtesy of the former Section a large number of microscopes, many of them very fine instruments, were exhibited, and by means of them specimens of minerals and rocks were examined. This was the first joint meeting of Sections since the passage of the amendment to the By-laws removing the prohibition against it, and its success was beyond question.

Respectfully submitted,

THEO. D. RAND,
Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALÆONTOLOGY.

The Professor of Invertebrate Palæontology respectfully reports that during the year 1882 a course of 36 lectures on Physiography and Invertebrate Palæontology was delivered in the class-room of the Academy (commencing Jan. 6, and terminating May 9), which course was attended by an average of about 27 listeners, largely made up of teachers, male and female, from some of the more prominent institutions of learning in the city.

The additions to the Palæontological Department of the Academy's Museum, which will be found recorded in another place, have been during the present year comparatively insignificant; but no special attempts have been made to increase the collections in this direction, since it was deemed advisable not to further burden the department until more of the old stock had been worked off through arrangement and classification. The most important contribution received (although not yet formally presented to the Academy) is that of true Nummulites from the Peninsula of Florida, the first and only representatives of that highly important group of organisms thus far discovered on the continent of North America.

The work of labeling and classifying the old collections in the Palæontological Department of the Academy has made considerable progress during the year, the determination of specimens embracing material contained in about 300 trays. The Conservator is pleased to state that almost the entire series of Tertiary fossils of the eastern United States—Eocene, Oligocene, Miocene, and so-called Pliocene—is now satisfactorily displayed and labeled, the re-determination and identification of species having been effected for upwards of 1700 trays. The collection, as it now stands, constitutes by far the most important and typical collection of tertiary invertebrate fossils in the country, and must form for some time to come the groundwork for any standard work bearing upon this section of American palæontological history.

The department of the library pertaining to Geology and Palæontology has received many valuable accessions during the year, for a considerable portion of which the Academy is again indebted to the liberality of Mr. Joseph Jeanes.

The department is also largely indebted to Mr. Chas. F. Parker, Curator-in-charge, who has kindly undertaken the mounting of specimens.

Respectfully,

ANGELO HEILPRIN,

Professor of Invertebrate Palæontology.

REPORT OF THE PROFESSOR OF MINERALOGY.

The Professor of Mineralogy respectfully reports that in addition to the usual work of classifying the collections under his charge, he has delivered during the winter and spring of 1882, a course of 28 lectures on Mineralogy.

The lectures, given under the auspices of the Committee on Instruction, began on January 5, 1882, and were given tri-weekly in the class-room of the Academy. They included an examination of the valuable collection of the Academy, and practical demonstrations of the method of determining minerals both by their external and by their chemical characters.

The mineralogical collection is gradually increasing in size and in value. In the absence of any specific fund for the purchase of new specimens, it has not been possible to add to its number of species except by exchange or through donations. Special care has been taken that where minerals are acquired by exchange or otherwise, preference should be given to species not in the collection. 300 specimens have been received through donation or exchange, 37 of which are species new to the collection. A detailed catalogue of these, with the donors, is given in the appended list, the minerals new to the collection being printed in italics. The most noteworthy addition to the collection has been the donation of Mr. J. M. Hartman of a large number of specimens. The lithological collection has also been increased by some 43 specimens. The labeling and mounting of the specimens has been performed as before by Mr. Chas. F. Parker, Curator-in-charge, whose skill in such work has greatly increased the beauty of the collection.

The attention of the friends of the Academy is again drawn to the necessity of mineralogical apparatus for the prosecution of advanced mineralogical work. The Professor of Mineralogy has been unable to properly classify the large collection of feldspars

in the Academy, for want of a suitable polarizing microscope. The work will be undertaken as soon as an instrument is obtained. The micas have been classified by the aid of an instrument made at his own expense. A reflecting goniometer is also greatly to be desired, both for class instruction and for the proper determination of many crystalline forms in the collection.

By the death of Mr. Wm. S. Vaux the Academy has lost a most liberal contributor to the mineralogical collection. Arrangements are now in progress, which it is hoped will result in transferring his very valuable collection to the custody of the Academy.

Respectfully submitted,

H. Carvill Lewis,
Professor of Mineralogy.

The election of Officers for 1883 was held, with the following result:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	William C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.,
	Chas. F. Parker,
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.
Councillors to serve three years, . . .	Thomas A. Robinson,
	Edward Potts,
	Isaac C. Martindale,
	Theodore D. Rand.
Finance Committee, .	Isaac C. Martindale,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	George Y. Shoemaker.

ELECTIONS DURING 1882.

MEMBERS.

January 31.—Robert B. Haines, Jr., Alfred C. Harrison, Abel F. Price, M. D., Rev. W. J. Holland, Chas. H. Hutchinson, Wilson Mitchell.

February 28.—Frank E. P. Lynde.

March 28.—John Edgar, M. D., Eugene M. Aaron, Geo. Taylor Robinson, M. D.

April 25.—Thomas Moore, M. D.

June 27.—Henry Howson.

September 26.—William M. Gray, M. D.

November 28.—F. Lynwood Garrison, Mrs. H. Carvill Lewis.

CORRESPONDENTS.

January 31.—Dr. A. Baltzer, of Zurich; Prof. Robert Collett, of Christiania.

February 28.—Prof. Robert Hartmann, of Berlin; Prof. W. Kowalevsky, of Moscow; Dr. K. Martin, of Leyden.

July 25.—Dr. Maxwell T. Masters, of London.

ADDITIONS TO THE MUSEUM.

December 1, 1881, to December 1, 1882.

Mammals.—Dr. Thomas Biddle. Mounted specimen of *Ornithorhynchus anatinus*, Australia.
Dr. H. C. Eckstein, U. S. N. Skull and tusks of *Odobænus rosmarus*, Spitzbergen.
Jos. Jeanes. Mounted skeleton of domestic hog.
Dr. Joseph Leidy. *Hesperomys leucopus*, N. J.
P. Reuter. Fœtus of horse.
A. S. Sweeten. Fungus parasite on young rat.
G. & A. Ulrich. Mouse (monstrosity).
James F. Wood, through E. M. Aaron. Female human skeleton, Cooper's Pt., N. J.
W. S. Vaux. Two Indian skulls, Hamilton Co., Ohio.
Birds.—Phila. Zool. Society. *Polyborus tharus*, S. A. *Porphyria melanotus*, Australia. *Penelope pileata*. Brazil.
Dr. H. C. Eckstein. Skins of *Larus tridactylus*, *Fulmurus glacialis* and *Somateria v. nigra* with nest and three eggs, Spitzbergen.
B. H. King. *Tyrannus carolinensis*, Calhoun, Ga
Ophidians, Reptiles and *Fishes.*—Phila. Zool. Society. *Python moluris* (2 specimens), India.
A. A. Alexander. *Heloderma horridum*, Arizona.
Dr. Geo. W. Lawrence. Double-headed snake, Hot Springs, Ark.
T. R. Peale. *Pseudemys rugosa*. Rehoboth, Del.
C. H. Townsend. *Menopoma alleghaniense*, Pa.
Mrs. M. A. Haldeman. Beak of *Pristis*, Essequebo River, Demerara.
Dr. W. N. Whitney. *Hippocampus*, *Ostracion* and lower jaw of *Cestracion*, Japan.
Articulates.—W. Y. Heberton. *Limulus polyphemus*, Cape May Point, N. J.
Jos. Jeanes. Sixteen species crustaceans, San Diego, Cal.
Mrs. M. T Keemblé. Two cases of insects, Brazil.
Dr. Joseph Leidy. *Balanus balanoides*, Bass Rocks, Gloucester, Mass.
Dr. Joseph Wilson. Galls on cultivated grapevine.
W. N. Lockington. *Astacus nigrescens*, Cal.
Maria J. Moss. *Mantis carolina*, Washington, D. C.
Mollusks.—Arango, R. Thirteen species of land shells from Cuba.
Barber, E. A. Fourteen species of land and fresh-water shells from Colorado. *Helix strigosa. H. fulva, H. suppressa, H. pulchella, H. striatella, Sphærium solidulum, Pisidium virginicum, Physa heterostropha, Planorbis parvis, Limnæa caperata, Pupa Blandi, P. Rowelli, Vitrina Pfeifferi* and *Ancylus*.
Beddome, C. E. 123 species of Tasmanian marine shells, mostly new to the Academy's Collection, and recently described by Rev. J. E. Tenison-Woods.
Bland, Thomas. Nine species of land shells from various localities.
Brazier, John. *Voluta marmorata, V. punctata, V. Ellioti. V. Norrisi, Bulimus Rossiteri* (types), *Cypræa Bregeriana, C. quadrimaculata, C. stolida, C. Walkeri, Murex Angasi*; twenty-five species, mostly marine shells, from various localities; forty-eight species and varieties of marine shells from Australia.
Brown, J. J. Four species of marine shells from Honduras.
Bush, Mrs. A. E. *Pecten monotimeris* Con., Cal. 17 species of land, fresh-water and marine shells, from various localities.
Bush, Mrs. A. E. Nine species of land and fresh-water shells from California.

Clark, T. W. B. *Martesia cuneiformis*, Chesapeake Bay, Md.

Conchological Section. 221 species of shells, all new to the collection, purchased; Glass models of *Eledone moschatus*, *Doris debilis*, *Doriopsis clavulata*, and *Flabellina janthina*.

Coulter, Prof. J. M. Two specimens of *Hippopus maculatus*.

Cox, Dr. J. C. Thirty-four species of marine shells from Australia; *Neæra latisulcata*, N. S. Wales.

Forbes, J. A. *Planorbis exacutus*, Illinois.

Ford, John. *Natica heros* and *N. duplicata*, Newport, R. I.; *Clea cochlea*, Sandwich Islands; *Cypræa helvola*, Singapore; *Casidula rugata*, Australia; *Cypræa lurida* (abnormal); *Bulimus Binneyanus* Pfr., Peru.

Hartman, Dr. W. D. *Auricula* (sp.), Japan; *Vitrina Thomsoni* and *Neritina pulligera*, Australia; *Physa osculans*, *Helix strigosa*, from N. Mexico· *Bulimus loyaltyensis*, Loyalty Isl.

Hutton, Prof. F. W. Sixteen species (types) of marine shells from N. Zealand.

James, Jos. F. *Limax maximus*, Cincinnati, O.

Jeanes, Jos. Twenty-eight species of marine shells from California; thirty-three species of marine shells, San Diego, Cal.

Keehmlé, Mrs. M. T. Three eggs of *Bulimus ovatus*, from Brazil.

Latchford, F. R. *Vertigo ovata* Say; *Amnicola decisa* Hald., Quebec, Can.; *Unio ventricosus*, Ottawa River, Ontario.

Lawrence, Dr. Geo. W. *Goniobasis symmetrica* Hald., N. Carolina.

Leidy, Dr. Jos. Five specimens of *Solen ensis* (with animal), Atlantic City, N. J.; *Purpura lapillus*, *Littorina littorea*, Bass Rock, Gloucester Co., Mass.

Orcutt, C. R. *Pupa hordeacea*, San Diego, Cal.; six species of shells, San Diego, Cal.; *Murex trialatus*, *Acmæa patina*, *Chiton pseudodenticus*, *Physa distinguenda*, *Lymnæa Adelinæ*, *Succinea oregonensis*; five species of shells, San Diego, Cal.

Potts, Edw. *Sphærium securis*, Prime, N. J.

Ryder, J. A. Egg-cases of *Buccinum undatum*, *Limax maximus* (dissection), *Ostræa virginica* (yearling). *Ostræa edulis*.

Spinner, Hon. F. E. *Arca floridana* and *A. americana*, Florida; *Fusus carica* and var. *eliceans*, *Arca floridana*, Florida.

Streng, L. H. Nine species of fresh-water shells; *Anodonta imbricata*, *A. imbecilis*, *A. modesta*, *A. ovata*, *A. subgibbosa*, *A. Houghtonensis*, *A. Benedictii*, *Unio ventricosus* and *Succinea Higginsi*, from Michigan.

Tryon, Geo. W., Jr. Ten glass models of Mollusca; *Tremoctopus violaceus*, *Verania sicula*, *Helix pomatia* (dissected), *Clionopsis Krohnii*, *Tiedemannia neapolitana* (development), *Lophocercus viridis*, *Parmarion papillaris*, *Daudebardia rufa*, *Parmacella valenciennesi* and *Vaginulus Moreleti*; *Goniobasis virginica*, Mt. Vernon, Va.

Wetherby, Prof. A. G. Eleven species of land and fresh-water shells, N. Carolina; also *Helix alternata* (ribbed variety), *H. Sayi* (var. *chilhoweensis*), Tennessee; *Planorbis glabratus* and *Physa gyrina*, Florida; seven species of land and fresh-water shells from Miami Co., Florida.

Whitney, Dr. W. N. Six species of marine shells from Japan; ten species of marine shells from Yenoshima, Japan.

Willcox, Jos. *Cyrena carolinensis*, *Succinea ovalis* and *Helix septemvolva*, Fla.; *Unio luteolus*, Oneida Lake, N. Y.; *Unio complanatus* Sol., Ontario; *U. complanatus* Sol., Oneida Lake, N. Y., and *U. rectus* Lam., Oneida Lake, N. Y.

Echinodermata.—Jos. Jeanes. *Strongilocentrotus purpuratus*, *S. franciscanus*, *Toxopneustes semituberculatus*, *Echinarachnius excentricus*, *Centrostephanus coronatus*, *Diadema* (sp.), *Ophiura panamensis*, *Ophiothrix spiculata*, *Ophiplocus esmarki*, San Diego, Cal.

W. N. Lockington. *Echinarachnius excentricus*, *Asterias æqualis*, *Ophiura panamensis* and *Astropecten* (sp.), Cal.

Dr. W. N. Whitney. Three species of Echinoderms, Japan.

Cœlenterata, etc.—Jos. Jeanes. *Astropecten stellatus*, *Asterias capitata*, *Asterias* (sp.), *Patiria* (*Asterias*) *miniata*, *Scytaster* (sp.), *Stylatula elongata*, San Diego, Cal.

Miss Drysdale. *Actinia rapiformis*, Atlantic City, N. J

Edw. Potts. *Alcyonidium ramosum* on Stones' Inlet, Atlantic City, N. J., and *Plumatella vesicularis*.

Rev. E. W. Lyle. *Hyalonema mirabilis*, Japan.

Joseph Willcox. Sponge. Florida.

Vertebrate Fossils.—Late Wm. M. Gabb. Seven species of reptiles and fishes, from the cretaceous of Kansas.

E. Florence. Tooth of *Oxyrhina*, Central Australia.

Rev. S. H. Lighthipe. Fragments of jaw of gavial, from the cretaceous marl of Burlington Co., N. J.

W. S. Vaux. Two molars of *Mastodon americanus*, Dick's Creek, Butler Co., Ohio. Three molars of *Elephas primigenius* and lower incisor of *Hippopotamus amphibius*.

Invertebrate Fossils.—Dr. H. C. Eckstein. Carboniferous Limestone, containing *Productus semistriatus* Martin, *P. horridus*, *Aviculopecten* and *Spirifer*, Green Harbor, Spitzbergen.

Joseph Jeanes. *Chione fluctifraga*, *Chione succincta*, *Pecten æquisulcatus*, *Pecten* (*Janira*) *dentata*, *Lucina Nuttalli*, *Lucina*, sp., *Scalaria*, sp.; *Acervularia Davidsoni*, Niagara Group.

Dr. I. Lea. *Panopæa americana*, miocene of Maryland; *Astræa*, miocene of Va.; Corals and bryozoan earth from the greensand, Long Branch, N. J.

Dr. Joseph Wilson. Crinoidal limestone and *Lithostrotion canadense* from the Burlington limestone, Burlington, Iowa.

Archæology.—George C. Hen‹zey. Arrow-head, Pennsgrove, Salem Co., N. J.

Dr. Harry Skinner. Arrow-point, Fairmount Park, Phila.

Plants.—Wm. M. Canby. Section and part of trunk of *Alnus maritima* Muhl.; nine hundred and seventy-one species plants from Europe, Africa, Asia and Australia.

Thos. Meehan. Forty-two species of *Acacia*. Fruit of *Diospyros kaki* and of *Cydonia japonica*. Cones of *Pinus densiflora* and *Pinus Bungeana*, natives of Japan. Thirty-five species of Cactaceæ, from Arizona and southern California; fourteen species of miscellaneous plants from Western N. Am.

Isaac C Martindale. Ellis's North American Fungi, centuries VIII and IX; twenty-nine species of plants from Europe, Australia and N. America.

Baron Ferdinand Müller, of Melbourne, Australia. Two hundred and eighty-four selected species of Australian plants, mostly new to the Herbarium.

John Tatum, of Woodbury, N. J. Section of stem of an old and intertwined *Wistaria Sinensis*.

Hugh D. Vail. Fine specimen of *Echinocactus Wislizeni* Engelm., from vicinity of "Total Wreck" Mine, Arizona.

Dr. A. Gray, of Cambridge, Mass. A second collection (seventy-one species) of plants from Kuram Valley, Afghanistan, made by Major J. E. T. Aitcheson, of British Army, in 1880. Also nine hundred and fifteen species plants from China, Japan, Formosa, Australia, Mexico and Texas.

Charles F. Parker. Forty-three species of N. American Ranunculaceæ; also eleven species of other N. American plants, including three type specimens of Austin's new species.

George E. Davenport, Boston, Mass. Nine species of ferns collected in Unalaska, in 1881, by L. M. Turner.

Charles E. Smith. Specimens of the rare *Corema Conradii* Torr., male and female plants from Shawangunk Mts., Ulster Co., N. Y.

Aubrey H. Smith. Specimens of the same—male and female plants of spring and fall growth, from same locality, and of *Empetrum nigrum*, from Island of Mt. Desert, Maine.

S. B. Buckley, Austin, Texas. *Nymphæa ampla* D. C., from Lampaza Springs, Mexico.
J. G. Lemmon, Oakland, Cal. Cones of *Pinus Arizonica* Engelm., and of *Pinus Chihuahuana* Engelm., from Arizona.
Horace J. Smith, St. Barbara, Cal. *Casuarina quadrivalvis*, an Australian species, cultivated in California.
F. C. Bell, Phila. Photograph of some Hymenocetous Fungus, from one hundred and fifty yards depth in Miller's Colliery, Phœnix Park, Schuylkill Co., Pa.
Charles S. Sargent, Forestry Department of U. S. Census. Fifty-four species shrubs and trees mostly from Western N. America, and Cones of eight species of Conifers from Oregon.
Thomas Bland, N. Y. Specimen of "Dagger Film," prepared from the inner leaves of the Dagger Plant, or *Yucca aloifolia;* used by ladies in Jamaica for making artificial flowers, and for water color painting.
F. L. Scribner. Six species grasses, from Washington Terr. and California.
B. D. M. Langdon, Mobile, Ala. Immature Cones of *Araucaria imbricata* Pavon, native of Chili, cultivated at Mobile.
J. M. Hutchings, Yosemite, California. Specimen of *Sarcodes sanguinea* Torr. in fruit, and of *Pterospora andromedea* Nutt, both from California.
Dr. G. W. Lawrence. Seed vessels of *Oenothera triloba* Nutt, from Hot Springs, Arkansas.
John H. Redfield. Six hundred and seventy-seven species of N. American plants, mostly from Florida, Arizona, Washington Terr., southern California, Texas, and the border provinces of Mexico.
Minerals [1]—Dr. W. D. Hartman. Aragonite, Birmingham Serpentine Quarries, Chester Co., Pa.
Dr. H. C. Eckstein. Bituminous Coal, Green Harbor, Spitzbergen.
The late Wm. M. Gabb. Native gold in magnetic sand, St. Domingo.
H. C Lewis. *Phytocollite*, Scranton, Pa.; Helvite, Amelia Co., Va.
Dr. Geo. W. Lawrence. Mountain leather, Salina Co., Ark.
Rev. S. H. Lighthipe. Fuller's earth, from the marl, Pemberton, N. J.
Dr. Jos. Leidy. White Tourmaline in limestone, De Kalb, St. Lawrence Co., N. Y.; Triphylite and Amblygonite, Mt. Mica, Paris, Me.; Rubellite, by decomposition passing into Steatite, Mt Mica, Me.; Cookeite with Steatite, Mt. Mica, Paris, Me.; Tourmaline passing into Lepidolite, Tourmaline in Lepidolite, Rubellite, Decomposed Rubellite, Mt. Mica, Paris, Me.
Theo. D. Rand. *Arksutite, Hagemannite*, Ivigtut, Greenland; *Hydrocuprite*, Lebanon, Pa.; Limonite from Serpentine, Ferruginous Quartz from Serpentine, near Newtown Square, Del. Co., Pa.
W. W. Jeffries. Serpentine with Marmolite, Brinton's Quarry, Chester Co., Pa.
W. L. Mactier. Anthracite Nodules, Luzerne Co., Pa.
Dr. Isaac Lea. Allanite and Zircon, Yellow Springs, Chester Co., Pa.
Jos. Willcox. Limonite altered from Serpentine, Middletown, Del. Co., Pa.
E. S. Reinhold. Copiapite, Mahanoy City, Pa.
Mrs. M. A. Haldeman. Catlinite, Head of Pipestone Creek, S. W. Minn.
Wm. S. Vaux. Fine specimens of crystals of Calcite, of Analcime, Datholite and Calcite, Bergen Hill, N. J.; Crocoite and Pyromorphite, Wheatley Mine, Phœnixville, Pa.; Prehnite with Datholite and Pyrite, Bergen Hill, N. J.; Rubellite and Lepidolite in quartz, Mt. Mica, Me.; Gypsum, Monte Doneto, Bologna, Italy; Idocrase, Monte Somma, Vesuvius; Crystals of native sulphur, Girgenti, Sicily.
Mrs. S. L. Oberholtzer. Graphite (3 specimens), Chester Springs, Chester Co., Pa.
E P. Oberholtzer. Magnetite (3 specimens), Warwick, Chester Co., Pa.
Vickers Oberholtzer. Hematite, Pikeland Mine, Chester Co., Pa.
Jos. Jeanes. Meteoric iron, Cohahuila, Mexico; Glaucodot, Tunaberg, Sweden; Nephrite (Jade), Torrent de Arnotte, Alibert, Siberia; Large crystal

[1] Minerals new to the collection in *italics*.

of quartz, Mt. St. Gothard, Switzerland; Chiastolite, Lancaster, Mass.; Allanite. Edenville, N. Y; Pyromorphite, Ems, Nassau, Germany; Scheelite and Fluorite, Fürstenberg, Saxony; *Ærinite*, Arragon, Spain; *Walchowite* Walchow, Moravia; Lignite, Redwitz, Bavaria; Lignite, Germany; Lignite with Retinite, Grimma, Saxony; *Bast Coal*, Wettersau, Rhein-Pfalz; Obsidian (2 specimens), New Zealand and Island of Lipari, Medt.; Wood Opal (2 specimens), Nevada Co., Cal.; Tourmaline, near Lebanon, N. H.; Pyroxene (2 specimens), De Kalb, St. Lawrence Co, N. Y.; Chlorite, pseud. after Garnet, Spurr Mt. Mine, Mich.; Calcite incrustation, Clermont, France; Scapolite, Bob Lake, Canada.

J. M. Hartman. Native gold in quartz, Venezuela; Native gold in quartz, Arizona; Native gold in quartz. N. C.; Native silver in quartz (3 specimens), Mexico; Native capillary silver in quartz. Mexico; Crystallized copper, Lake Superior, Mich.; Ore Knob copper, N. C.; Dendritic copper, N. C.; Diopside, Garnet and Chlorite, Piedment, Ala.; Coccolite, Amity, N. Y.; Seybertite, Amity. N. Y.; Epidote, Tyrol; Emerald, Bogota; Labradorite, Labrador; Rutile, Macon Co., Ga.; Orthoclase (Amazon Stone). El Paso, Col.; Calcite, Guanajuato, Mexico; Calcite, Mineral Point, Wis.; Calcite, Lake Superior, Mich.; Calcite, loc.?; Sulphur, Lake Co., Cal.; Sulphur, Cal.; Graphite, Ceylon; Graphite. Ticonderoga, N. Y.; Graphite, Brockville. Canada; Sphalerite (Cleiophane). 3 specimens, Franklin, N. J.; Galenite, Japan; Galenite, Mine La Motte, Missouri; Cinnabar, Guadaloupe, Cal.; Wulfenite, Germany?; Wulfenite, Nevada; Heliotrope, India; Calcite, Rossie, N. Y.; Calcite and Copper, Lake Sup, Mich.; Amethyst, coated with Pyrite, Lake Sup., Mich.; Calamine (2 specimens), Franklin, N. J.; Halite (2 specimens), Colorado River, Arizona; Byssolite, Chester Co., Pa.; Ripidolite, Chester Co., Pa.; Moss Agate, Colorado; Nine polished Agates, Paraguay; Six crystals of Spinel, Amity, N. Y.; Limonite (2 specimens), Durham, Pa.; Limonite, Fox Hill, Shenandoah, Va.; Limonite shale, near Fogelsville, Pa.; Limonite (Kidney ore), Lake Superior, Mich.; Limonite, (5 specimens), from Negaunee, Mich.; Brown Tourmaline, Gouverneur, N. Y.; Apophyllite crystal. Bergen Hill, N. J.; Quartz, Japan; Quartz, Lancaster Co., Pa.; Smoky Quartz, El Paso, Col.; Quartz and Specular Hematite, Keswick, England; Yellow Quartz, Sardonyx, Chalcedony, Chalcedony artificially colored, Alps: Fluorite, Arizona; Hematite, Saxony; Hematite, England; Specular Hematite, Elba; Specular Hematite and Quartz, Elba; Ditto., Antwerp, N. Y.; Ditto. (Slickensides), Byram Mine, N. J.; Ditto., ditto., Negaunee, Mich.; Hematite Geode, Col.; Geodes of Calcite in Hematite, Rockwood, Tenn.; Hematite, pseud. of Calamite, Shawnee, Ohio; Hematite, Iron Mt., Mo.; Lenticular Hematite, Frankstown, Pa.; Micaceous Hematite, from Dillsburg, Pa., Rossie, N. Y., Negaunee. Mich, and Va.; Millerite in Hematite, Antwerp, N. Y.; Göthite, Pike's Peak, Col.; Actinolite, Sweden; Fahlunite in Talc, Fahlun, Sweden; Analcite and Mesotype, Nova Scotia; Natrolite, Bergen Hill, N. J.; Azurite, Cornwall, Pa; Talc, Fowler. N. Y.; Allanite, Sweden; Hornblende, Bohemia; Cassiterite, Australia; Galenite from Colorado, Utah. Arizona, and Sweden; Pyrite. Amboy, N. J., Roxbury, Conn.; Chalcopyrite, Rossie, N. Y., and Nevada Co., Cal.; Zincite and Franklinite, Franklin, N. J.; Zincite and Willemite, Franklin. N. J.; Zincite Foliated, Franklin, N. J.; Sapphire, Sparta, N. J.; Corundum. Ala.; Ilmenite, Amity. N. Y.; Magnetite from Durham, Pa., Lake Superior, Colorado and Mexico; Wood Agate, Col.; Augite and Calcite. Amity, N. Y.; Tremolite var. (Hexagonite), St. Lawrence Co., N. Y.; Mountain Leather, Sweden; Pargasite, N. Y.; Rœpperite, Franklin, N. J.; Willemite and Franklinite, Franklin, N. J; Garnets from Sweden, N. J., and Pa.; Tourmaline in Calcite, Sweden; Sphene, Pectolite, N. J.; Sepiolite, Chester Co., Pa.; Williamsite, Chester, Pa.; Kaolinite, Japan; Wavellite, Ark.; Barite from French Broad, N. C., De Kalb Co., Ga., Missouri, and Saxony; Fibrous Gypsum, Col.; Calcite, Sweden; Siderite,

Conn.; Aragonite, Col., and Mo.; Malachite, Japan; Chalcocite, pseud. after Wood, Texas; Manganite, Lake Superior, Mich.; Serpentine (Marmolite), Bergen Hill, N. J.; Tephroite, Willemite and Franklinite, Franklin, N. J.; *Ludwigite*, Moravicza, Bannat, Siederite in Quartz, Greenland; Obsidian (Pele's Hair) (artificial), Durham, Pa.; Orpiment (artificial), Galenite, Mine La Motte, Mo., and from Illinois; Chalcopyrite, Japan; Marcasite, Mine La Motte, Mo.; Cuprite, New Mexico; Menaccanite (Iserine), Bohemia; *Minium* (artificial), Sala, Sweden; Pyrolusite, Franklin, N. J.; Opal, San Diego, Cal.; Sahlite, Sala, Sweden; Pseud. of Chlorite after Garnet, Mich.; Phlogopite, Sterling, N. J., and Amity, N. Y.; Orthoclase (Lennilite) Lenni, Del. Co., Pa.; Tourmaline in Muscovite, Paris, Me.; Chlorastrolite, Lake Superior; Stilbite, Nova Scotia: Serpentine and Chrysolite, Westville, N. J.; Kaolinite, N. J.; Jefferisite, Chester Co., Pa.; Margarite, Chester, Mass.; *Durangite*, Durango, Mexico; Anglesite and Galenite, Arizona; Calcite (Spartaite), Sparta, N. J; Oölite, Utah; Calcareous Tufa, Japan; Dolomite on Quartz, Mexico; Bituminous Calcite, Sweden; Smithsonite, Mineral Point, Wis.; Strontianite, Georgia; Cerussite, Mexico; Hydromagnesite on Serpentine, Hoboken, N. J.; Azurite, Nevada; Willemite (Troöstite), Franklin, N. J.; Gieseckite, Diana, N Y.; Stalactite (Chalcedony), Florissante, Col; Agalmatolite, Serpentine, Rossie, N Y.

In exchange. Dyscrasite, Hartz Mts.; *Clausthalite*, Tilkesode, Hartz; *Alabandite*, Hagyag, Transylvania; *Breithauptite*, Andreasberg, Hartz; *Arite*, Pyrenees; Embolite, Silver City, N. Mexico; *Jacobsite*, Jacobsberg, Sweden; *Fulgurites*, Thompson, Carroll Co., Ill.; Amphibole (*Edenite*), Edenville, N. Y.; *Arfvedsonite*, Greenland; *Forsterite* (Boltonite), Bolton, Mass.; *Gehlenite*, Mt. Monzoni; *Keilhauite*, Snarum, Sweden; *Catapleiite* and Astrophyllite, Norway; *Faujasite*, Baden; *Antillite*, Cuba; *Sipylite*, Amherst Co., Va; *Diabantite*, Bergen Hill, N J.; *Chalcosiderite*, Cornwall, England; *Arseniosiderite*, France; *Borikite*, Bohemia; *Bindheimite* (Bleinierite), England; *Howlite* from Gypsum, Hants, N. S.; *Warwickite*, Edenville, N. Y.; *Hübnerite*, Mammoth District, Nevada; *Cuproscheelite*, La Paz, Cal.; *Cyanotrichite*, Cape Garonne, France; *Dawsonite*, Montreal, Canada; *Schraufite*, Germany; Natrolite and three specimens of Apophyllite, Bergen Hill, N. J.; White Garnet, Hull, Quebec, Canada.

Rocks —Dr. H. C, Eckstein. Coal, with associated rocks, Green Harbor, Spitzbergen; Fossiliferous rock, Concretion Quartz, Green Harbor, Spitzbergen; Quartz, Mica-schist and Gneiss, Hammerfest, Norway.

E. S. Reinhold. Diorite (Napoleonite), American River, Cal.

Theo. D. Rand. Steatite with cavities formerly containing pseudomorphs of Serpentine after Staurolite, near Merion Square, Montgomery Co., Pa.; four lead casts of pseudomorphs of Serpentine after Staurolite; seven Rock specimens from neighborhood of Philadelphia; Actinolite, Wissahickon Creek, Phila; Actinolite decomposing, Wissahickon Creek, Phila.

Dr. Jos. Leidy. Twelve specimens showing natural jointed fracture, from the Potsdam Sandstone, South Mountain, near Wernerville, Bucks Co., Pa.; Black Hornstone pebble, with rhombs of Calcite, from the Delaware shore, Easton, Pa.; Granitoid pebbles, Quartz and Mica, from the gravel on the Almshouse ground, Phila.; Pebbles of Quartzite, from the gravel, Phila.; Pebble simulating a stone hammer, from the gravel of the University ground, W. Phila.; Probable Coprolite, Phosphate beds of Ashley River, S. C.

Dr. W. N. Whitney. Lava, Japan.

A. H. Smith. Rhomboidal pebble, from the gravel near Tinicum, Delaware Co., Pa.

A. Kollner. Ringing rock, Del. Narrows, Bucks Co., Pa.; Rock containing Garnets, Bryn Mawr, Pa.

W. H. Harned. Calcareous Tufa with imbedded leaves, near Natural Bridge, Va.

J. M. Hartman. Serpentine and Chrysolite, Westville, N. J.; Serpentine, Del. Co, Pa.; Unakyte, French Broad, N. C.; Tremolite, Chile; Calcareous nodule.

ADDITIONS TO THE LIBRARY.

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Baillon, M. H. Dictionaire de Botanique, 14me Fasc. I. V. Williamson Fund.
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Ball, V. Manual of the Geology of India. III. Economic Geology. Geological Survey of India.
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Baraga, R. R., Bishop. A dictionary of the Otchipwe language, explained in English. II. Otchipwe-English. F. V. Hayden.
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 Mound pipes. The Author.
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 De l'application du microscope à l'étude de la minéralogie.
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 Sur les differences entre les propriétés optiques de corps crystallidés birefringents et celles que peuvent présenter les corps monorefringents.
 Propriétés optiques de la Beudantite et de la pharmacosidérite.
 Sur les cristaux pseudo-cubiques.
 Étude optique des différents mineraux.
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 Sur les propriétés optiques des corps cristallises presentant la forme spherolithique.
 Sur la leadhillite de Matlock. G. Vaux.
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Boek, Axel. De Skandinaviske af arktiske Amphiopoder. Andet Hefte. University of Norway.
Bonpland, A. and A. Humboldt. Nova genera et species plantarum quas in peregrinatione ad plagan æquinoctialem orbis novi collegerunt descripserunt. 7 vols. text and 7 vols. atlas. Jos. Jeanes.

Borre, A. P. de. Description d'une nouvelle espèce de Buprestide, du genre Sternocera.
Sur les metamorphoses des Rhagium.
Du peu de valeur du caractère sur lequel a été établi le genre ou sous-genre Rhombonyx.
Sur le Carabus cancellatus et sa variété fusus.
Liste des Criocérides recueillies au Brésil par feu Camille van Volxem, suivie de la description de douze nouvelles espèces Americaines de cette tribu. The Author.
Boulenger. G. A. Catalogue of the Batrachia salientia S. ecaudata in the collection of the British Museum. 2d Ed. Trustees of the British Museum.
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Notes on some coleoptera of the genus Plusiotis. The Author.
Boué, A. Autobiographie du.
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Brazier, J. Description of a new Bulimus from New Caledonia.
Helix pulchella and H. cellaria of Mueller, from Australia.
List of Cypræa found in Moreton Bay, Queensland.
Note on a specimen of malformed Cypræa.
Remarks on Megapodius Brazieri.
List of marine shells, collected on Fitzroy Island, North Coast of Australia.
A new variety of Bulimus Caledonicus.
Recent mollusca, found in Port Jackson, etc.
Localités des Isles Australiennes, etc. The Author.
Breidler, J., and J. B. Förster. Die Laubmoosflora von Oesterreich-Ungarn. Royal Zoologico-botanical Society of Vienna.
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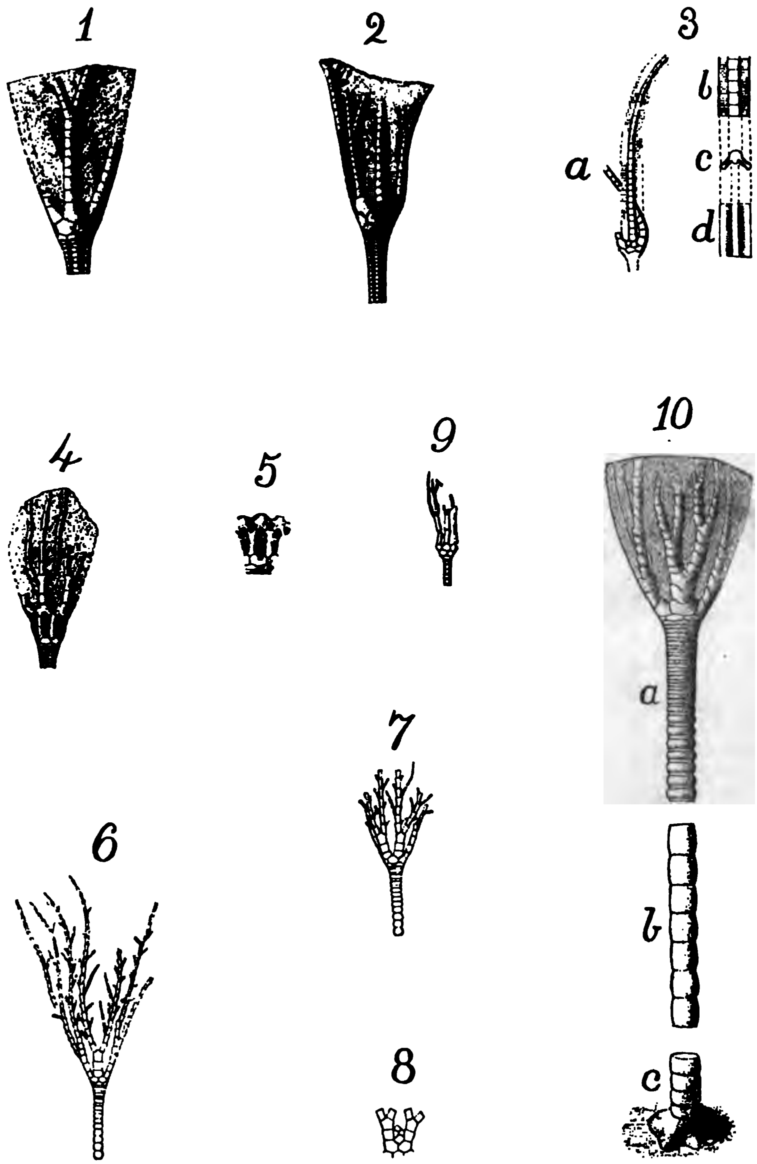

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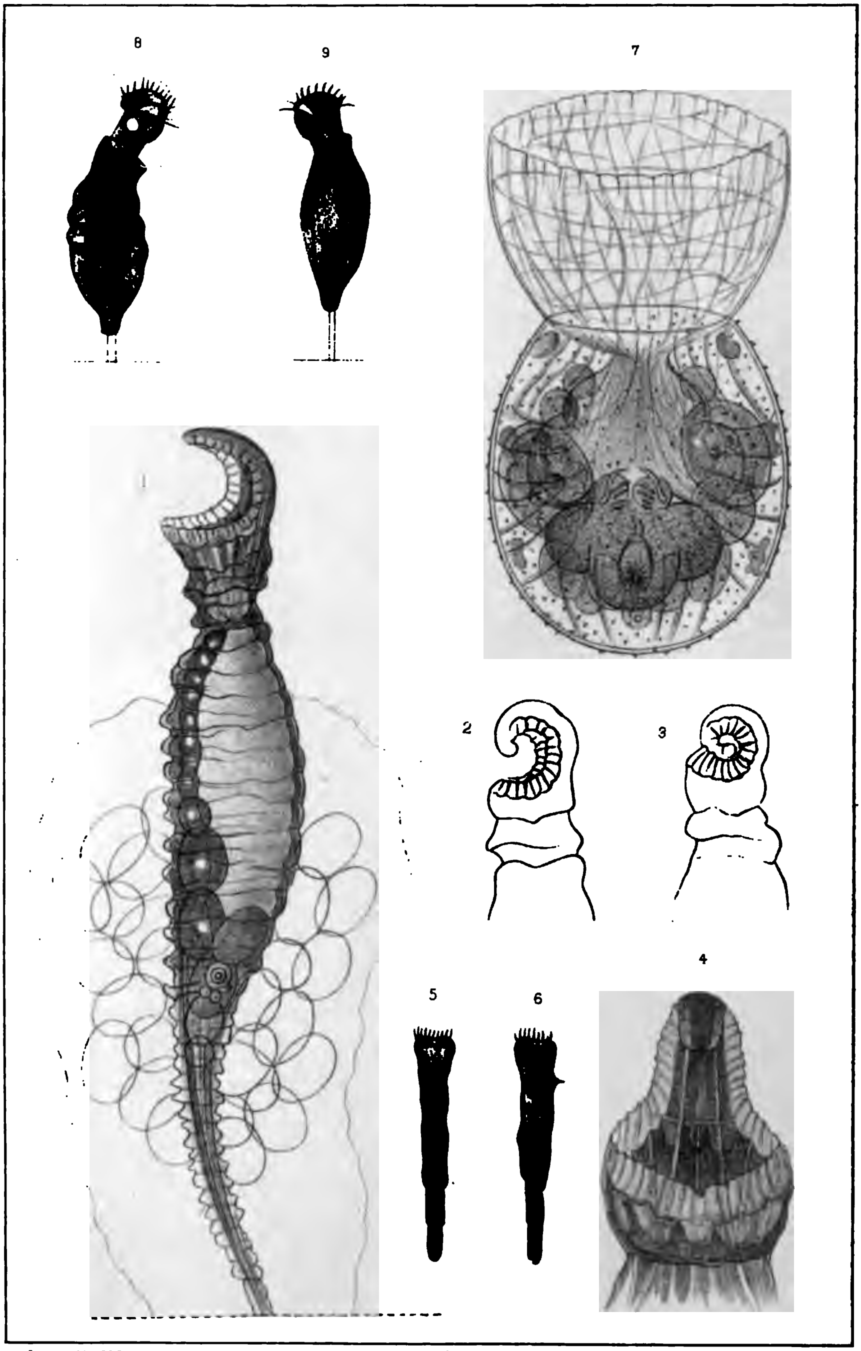

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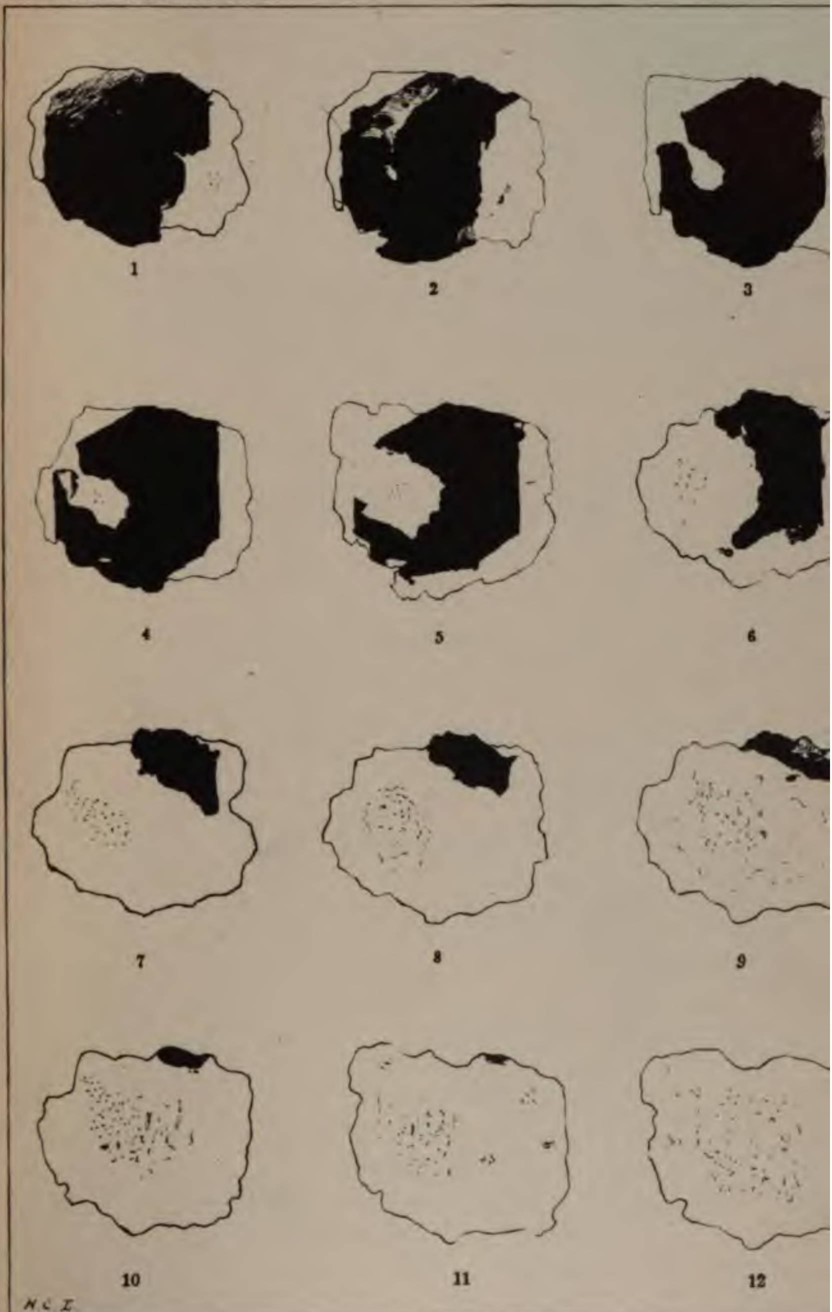

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OF

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1883.

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EDWARD J. NOLAN,
Recording Secretary.

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1883.

JANUARY 2, 1883.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

The deaths of J. T. Reinhardt, of Copenhagen, a correspondent, and of Edmund Draper, a member, were announced.

JANUARY 9.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

A paper, entitled "Notes on the Geographical Distribution of Batrachia and Reptilia of Western North America," by Edw. D. Cope, was presented for publication.

JANUARY 16.

Rev. HENRY C. McCOOK, D. D., Vice-President, in the chair.

Twenty-one persons present.

A paper, entitled "On Quercus Durandii," by S. B. Buckley, was presented for publication.

The following was ordered to be printed:—

NOTES ON THE GEOGRAPHICAL DISTRIBUTION OF BATRACHIA AND REPTILIA IN WESTERN NORTH AMERICA.

BY E. D. COPE.

The following notes are based on collections made by myself and my assistants at various points in the Rocky Mountain and Pacific regions during the last ten years. They describe the range of various species of our terrestrial cold-blooded vertebrata, and contribute to the final definition of the zoölogical provinces and districts of the continent.

1. Lake Valley, New Mexico.

This locality is at the western border of Doñana County, twenty miles N. E. of Fort Cummings. It is in the foot-hills of the Mimbres or Negretta range. The region is rather arid, springs not being numerous; but during July and August there are frequent rains. Vegetation is abundant in the form of grass and herbaceous plants and shrubs.

Scaphiopus sp. Young.

Rana halecina Kalm.

Phrynosoma cornutum Harl.

Full of eggs in June.

Phrynosoma modestum Gird.

Very abundant in August; not seen during two days' visit in June.

Crotaphytus collaris Say. Abundant.

Uta schotti Baird.

There is but one median smaller row of dorsal scales, so that the single specimen approaches the *U. nigricauda*. Specimens of this genus are abundant.

Sceloporus

A large species seen.

Sceloporus.

A small species seen.

Holbrookia maculata B. and G. Abundant.

Var. *flavilenta*, differs from the typical form in having larger prenasal scales separated by only two flat scales in front instead of four tubercular ones, and in having only four flat scales between the

nostrils above instead of six tubercular ones, and in having the scales of the front flatter. The spots are obscure or entirely wanting; when present they are more numerous than in the var. *maculata*, there being eight between axilla and groin instead of six. The sides and dorso-lateral regions are thickly marked with small yellow spots. Two specimens.

Cnemidophorus sexlineatus L.

Very abundant.

Stenostoma dulce Bd. and Gird.

One specimen.

Bascanium testaceum Say.

Eutænia cyrtopsis Kenn.

Eutænia ornata B. and G.

Crotalus scutulatus Kenn. Not rare.

Crotalus confluentus Say, var. **pulverulentus** Cope.

I propose this name for a well-marked variety of rattlesnake, which is abundant in the region of Lake Valley, especially on the grassy plains. In order to determine its relations to the species to which I refer it, I instituted a comparison with the allied forms represented in my collection. These are: Two specimens from Fort Benton, Montana; two from Central Oregon; two from Eastern California; one from Socorro, New Mexico; one from Fort Wingate, New Mexico; two from Lake Valley, New Mexico, and one from Haskell County, Texas. These represent a wide range in latitude, and are likely to give the greatest range of variation. The comparison indicates three varieties, defined as follows:—

Cephalic scales larger; four rows between superciliary plates; four rows below orbit; dorsal spots and cephalic bands light-edged; few posterior cross-bands; *confluentus.*

Cephalic scales intermediate; six rows between superciliaries; three rows below orbit (probably sometimes four); dorsal spots square, with the head-bands, not light-edged; posterior cross-bands more numerous; colors dotted with brown specks; *pulverulentus.*

Cephalic scales smallest; eight rows between superciliaries; four rows below orbit; dorsal spots and head-bands light-edged or not; numerous posterior cross-bands; *lucifer.*

The var. *pulverulentus*, at first sight, resembles the *Crotalus mitchilli*, having much the same coloration, but the head-scales and

plates are quite different. It gives out a powerful musky odor when excited, which I have not noticed in the typical form of the species. It is quite probable that it is to this variety that the specimens from Arizona should be referred, which I have heretofore placed under *C. lucifer*.[1] Not having access to the specimens at this time, I cannot determine this point positively. Of those above enumerated, the specimens from Fort Benton, Fort Wingate, from Socorro, and from Texas, belong to the typical *C. confluentus*. The others are the *C. c. lucifer*.

Crotalus molossus B. and G.

I killed a fine specimen of this species, which I discovered in the act of springing through a bush. When I struck it, it was suspended over a branch, looking at me. It was heavy in its movements, except at the moment of leaping.

2. Socorro, New Mexico.

The collection from this region was made by Prof. Frank Snow, of the University of Kansas, at Lawrence. I here express my indebtedness to Prof. Snow for the opportunity of studying it.

Phrynosoma modestum Girard.

Phrynosoma cornutum Harl.

Phrynosoma douglassi Bell.

Crotaphytus collaris Say.

Holbrookia texana Trosch.

Holbrookia maculata B. and G.

Sceloporus poinsettii B. and G.

Uta stansburiana B. and G.

Cnemidophorus sexlineatus L.

Diadophis regalis Bd. and Gird.

The first time this rare species has been found within the limits of the United States. The single specimen obtained differs from the typical one in having eight superior labials, with the eye above the fourth and fifth. As the preorbital labials are very short, variation to seven in all may be anticipated, as is found in the type. This specimen is smaller than the one from Sonora originally described.

Bascanium constrictor L.

Eutænia marciana B. and G.

The common species of the Rio Grande valley.

---

[1] Proceedings Philada. Academy, 1866, 807.

Crotalus confluentus Say.

Typical variety from near the southern end of the Socorro Mountain, five miles from Socorro.

Crotalus lepidus Kennicott.

Prof. Snow was fortunate enough to obtain the first entire specimen of this species, it having been described by Kennicott from two heads. We are thus made acquainted with the most peculiar of the North American rattlesnakes. I proposed for it the genus *Haploaspis* on account of the undivided nasal plates of the typical specimens. In the present specimen, that plate is divided below the nostril. It is therefore probable that this generic name should be abandoned.

Mr. Kennicott has well described the scutellation of the head. It may be summarized here by saying that the top of the muzzle is covered by eight smooth scuta; that the rostral plate is rather low, and is in contact with the prenasal; that there are two preoculars and two loreals; and that but two scales separate the orbit from the superior labial scuta. Of the latter there are twelve. Occipital scales smooth. Scales of body in twenty-three rows, the two external on each side smooth. Urosteges, 153; gastrosteges, 27. The rattle consists of seven segments and a button, and narrows gradually towards the extremity.

The color above is a greenish gray, which is crossed by nineteen jet-black rings on the body, which do not extend on the abdomen. These rings are two and a half scales wide on the middle line, and narrow downwards on each side so as to cover but one scale in width. The scales which border the annuli are half black and half green, the effect of which is to give the edge of the ring a turreted outline. The edges of the ground-color are paler than any other part of the scales, thus throwing the black into greater relief. A large black spot, shaped like two hearts side by side, with the apices posterior, marks the nape; and there is an irregular small black spot on each side of the occiput. Some black specks between the orbits. No other marks on the head. Near the middle of the gray spaces of the body, some of the scales of many of the rows have black tips. The tail is light brown above, and has a basal broad black, and two other narrow brown annuli. Below dirty white, with closely placed shades of brown.

Total length, m. ·555; to constriction of neck, ·027; length of tail, ·074; do. without rattle, ·026.

This is one of the smallest species of *Crotalus*, and is one of the most handsomely colored. Its coloration is entirely unique in the genus. The scutellation of the muzzle places it between the two sections of the genus, typified respectively by *C. horridus* and *C. durissus*.

The specimen was captured on the summit of the Magdalena Mountains, which are northwest from Socorro twenty miles.

3. St. Thomas, Nevada.

This locality is on the Virgen River, in southeastern Nevada, nearly in the latitude of the southern boundary of Utah. The collection now referred to was made by Dr. Edward Palmer and sent by him to the Smithsonian Institution. Through Professor Baird, the distinguished Secretary, it was referred to me for identification.

Bufo lentiginosus frontosus Cope.

This is the toad of the Great Basin, representing the *B. columbiensis* of more northern regions.

Crotaphytus wislizeni B. and G.

Cnemidophorus tessellatus Say.

Ophibolus getulus boyli B. and G.

The most northern locality for this species in the Great Basin. It has been previously obtained by Palmer and Coues, near Prescott, Arizona.

Phimothyra grahamiæ B. and G.

A variety with the dorsal bands nearly obsolete, and separated by three rows of dorsal scales on all parts of the body. Two preoculars on one side and three on the other. The most northern locality for this species.

4. Santa Fé, New Mexico.

Amblystoma mavortium Baird.

Not uncommon.

Spea hammondii Baird.

Abundant in July and August, when it deposits its eggs in the pools of rain-water. It is very noisy at such times, and the open lots in the city of Santa Fé resound with its cries. They are much like those of the *Scaphiopus holbrookii*.

The range of this species is extensive. It was originally obtained near Redding in Northern California. My friend, James S. Lippincott, has sent it to me from the extreme south of California, San Diego. The Smithsonian Institution has a slightly differentiated variety from Chihuahua; and a specimen from my friend Dr. Duges, from Guanajuato, Mexico, though rather young, is apparently the same. I suspect that the *Scaphiopus dugesi* Brocchi from that locality is the same species.

This species is much like the *Scaphiopus intermontanus* described further on. It is always smaller, and the middle pair of light dorsal bands is nearly always wanting. It is still more different from the *S. varius*, which has the vomerine teeth entirely posterior to the nares, banded upper lip and marbled back.

5. San Francisco Mountains, Utah.

Lizards are very abundant in this region, especially in the Wah Wah Valley, on the west side of the range.

Phrynosoma platyrhinum Gird.

Very abundant.

Crotaphytus wislizeni Bd. and Gird.

Very abundant.

Crotaphytus collaris Say.

Very common.

Uta stansburiana Bd. and Gird.

Abundant.

Sceloporus smaragdinus Cope.

Not rare.

Sceloporus consobrinus B. and G.

Cnemidophorus sp.

Many seen but not caught.

6. Provo and Salt Lake City, Utah.

Bufo lentiginosus frontosus Cope.

Abundant near Salt Lake City.

Scaphiopus intermontanus sp. nov.

I took a specimen of this species within the limits of Salt Lake City, and subsequently obtained three or four specimens from Pyramid Lake, Nevada. It resembles the *Spea hammondi* more than it does any other species. The frontoparietal bones, though

ossified, are not roughened as in the other species of *Scaphiopus*. It is nearest the *S. varius* (from near San Antonio, Texas). In that species the vomerine teeth are entirely posterior to the internal nares; in this one they are between the posterior borders of the same. The lips are not cross-barred as in the *S. varius*; and the superior region has two pale lines on each side. In *S. varius* these lines are replaced by a coarse marbling. As compared with *Spea hammondi*, this frog differs in its larger size, lighter colors, and the presence of the superior pair of light lines.

It represents the *S. hammondi* in more northern regions, and the complete cranial ossification and larger size mark it as a more fully developed form.

Rana halecina Kalm. From Provo.

Rana pretiosa B. & G.

A variety without a trace of dorso-lateral folds, and of a uniform dusky color above and on the sides. Lip not striped. The posterior part of the abdomen and the inferior face of the thighs are salmon-red. Skin smooth; diameter of membranum tympani three-fifths that of the eye. Salt Lake City. This is the most southern locality of this species known.

Sceloporus consobrinus B. & G. Provo.

7. Atlanta, Idaho.

Atlanta is a small town situated on the headwaters of the South Boise River, on the southern drainage of the Sawtooth Mountain Range. The valley is quite elevated, and is shut in by granitic mountains; water and vegetation are abundant; and the snow lies on the ground late in the spring. During a short visit there in 1882, I obtained the following species:

Amblystoma epixanthum sp. nov.

Nearly related to *Amblystoma macrodactylum* Baird, and to be placed next to that species in any synopsis of the genus.[1] Costal folds twelve. No canthus rostralis. Upper jaw overlapping lower. Tail strongly compressed, as long as head and body to groin. Head wide-oval; its greatest width one-fourth its total length to the groin. Digits all rather short; four phalanges in

[1] Proc. Acad. Phila., 1867, p. 171.

fourth posterior digit. Internal nares as widely separated as the external. Eye-fissure one-half width between the anterior canthus. Median dental series presenting an angle forwards. Tongue large, deeply plicate. Length, m. ·083; length to axilla, ·017; to groin, ·040; length of anterior limb, ·012; of anterior foot, ·004; of hind limb, ·014; of posterior foot, ·0065.

Sides of body and tail, and superior surfaces of limbs, shining black. Dorsal region to end of tail and muzzle, gamboge yellow. The yellow expands on the head, and forms two cross-bands on the upper surfaces of each of the limbs. The black of the sides is occasionally interrupted by the yellow spots irregularly placed. Below, dilute black, dusted with minute white speckles. The structural differences between this and the *A. macrodactylum* are not many, but are well marked. They are: 1. The greater width of the head, which enters the length (without the tail) five times in the latter, and four times in the *A. epixanthum*; and is also seen in the greater interorbital width. 2. In the short toes, which are very much longer in the *A. macrodactylum.* In color, this species is the more brilliant; the coast species being described as brown, with gray dorsal stripes, instead of black, with yellow dorsal stripes. In it the limbs are not banded, and the belly is uniformly pale, contrary to what holds in the present species, which is the most handsome of the genus. I obtained four specimens of this salamander, under logs, in a swamp near the head of the South Boise River, on the south side of the Sawtooth Mountain Range, Idaho.

Bufo columbiensis Bd. and Gird.

Abundant. I also obtained it at Bellevue on the Wood River, about one hundred miles southeast of Atlanta.

Bascanium vetustum Bd. and Gird.

Eutænia sirtalis Linn.

These are all, except the last, species characteristic of the northern fauna of Washington Territory. The *Bufo columbiensis* ranges to the headwaters of the Missouri.

8. Mouth of Bruneau River, Idaho.

This locality is on Snake River, which cuts through the great lava outflow of southern Idaho and Oregon. The reptiles are

different from those of Atlanta, and are those of the great basin of Utah. I am indebted to Mr. J. L. Wortman for these specimens.

Phrynosoma platyrhinum Gird.

Crotaphytus collaris Say.

Crotaphytus wislizeni B. and G.

Uta stansburiana B. and G.

Sceloporus smaragdinus Cope.

Pityophis catenifer Blainv.

Bascanium vetustum B. and G.

The head is a little longer than in a specimen from central Oregon, and the muzzle is less conical. The fifth superior labial just reaches the inferior postorbital.

9. From Reno to Pyramid Lake, Nevada.

The road from Reno to the southern extremity of Surprise Valley, California, passes through an arid and forbidding country. The rocks are entirely basaltic, and frequently present a rugged foundation for the road. The vegetation consists of *Artemisia*, and where alkali abounds, of *Sarcobatus*. North of Pyramid Lake, the dry alkaline flats once covered by the Alkali Lake, have a wide extent. During the hot weather of July, 1882, the region swarmed with lizards, and rattlesnakes were numerous. The greatest number of both was met with from Pyramid Lake northwards for twenty miles.

Bufo columbiensis Bd. and Gird. Pyramid Lake.

Scaphiopus intermontanus Cope.

With the preceding species in a pond near the shore of Pyramid Lake. Like other allied species, it was very noisy, almost obscuring the voice of the less vociferous *Bufo*.

Phrynosoma platyrhinum Gird.

Very abundant.

Crotaphytus collaris Say.

Crotaphytus wislizeni B. and G.

More abundant than the *C. collaris*.

Holbrockia sp.

A fine species was seen north of Pyramid Lake, but it was so swift that I did not succeed in catching a specimen. It resembles the *H. texana*, and may be an undescribed species.

Sceloporus smaragdinus Cope.

A variety with one additional row of small supraorbital scales, making six rows in all.

Cnemidophorus tessellatus Say. Abundant.

Bascanium sp. Young.

Crotalus confluentus lucifer B. and G. Cope emend. supra, p. 11.

Two specimens from Buffalo Canyon, north of Pyramid Lake. In one of the specimens the dorsal spots are first darker, then lighter-bordered, and there are twenty-three rows of scales on the body. In the other there are twenty-five rows of scales, and the spots have neither dark nor pale borders, but have pale scales scattered through them, and they have a more transverse form.

10. The Lakes of South and West Central Oregon.

This region possesses much zoölogical interest from the position which it occupies as the border-land between the faunæ of the Pacific slope and that of the great interior basin. It is here that we find the transition between the sage-brush (*Artemisia*) desert and the forest-covered Sierra Nevada Mountains and valleys. Here also we have the transition between the almost fresh lakes near the mountains, to the intensely alkaline ones east of them. An especial interest attaches to the lake faunæ; since we find in them the means of determining the characters of the fossils found in the remains of pliocene and post-pliocene lakes of the Oregon desert. This part of the subject will be more fully considered in an essay on the fishes of these lakes, now in course of preparation.

The routes on which the species of the list below given, were collected, are as follows: Along the east shore of the Great Klamath Lake to its northern extremity. From the eastern side of the lake northeastward to Silver Lake. This was part of my expedition of 1879. In 1882, I passed along the three southern Warner Lakes, and then crossed southwest to Goose Lake. Thence I traveled north to Summer Lake, crossing the Chewaucan River, which flows into Abert's Lake. Then north to Silver Lake, connecting with my route of 1879. After that, south to Goose Lake, passing along its entire eastern shore.

Bufo columbiensis Bd. and Gird.

Abundant throughout the entire region. It is especially numerous at Klamath Lake, where it covers the basaltic blocks which lie partially in the water, concealed by the *Typhæ*, which grow from the bottom. They accumulate there in large piles, sometimes as large as a bushel-measure, and afford abundant food for the *Eutæniæ*, which are scarcely less abundant. One specimen of

this toad was as large as the average *Bufo marinus* of Brazil, and a specimen seen at Warner's Lake was but little smaller.

Hyla regilla B. and G.

Abundant at Silver Lake, at Warner's Lake, Goose Lake and at Fort Bidwell, twenty miles east of Goose Lake, in California, I found numbers of what I suppose to be a variety of this species. It is little over half as large in linear dimensions, and the skin is more distinctly tubercular above. Some of those from Goose Lake are more spotted; those from Fort Bidwell are nearly uniform golden-yellow and green. This species lives in swamps and on the edge of water, representing in this region the *Acris* and *Chorophilus* of the east.

Rana pretiosa Bd. and Gird.

This is the characteristic *Rana* of the northwestern interior, being accompanied by *Bufo columbiensis* and *Bascanium vetustum*. In life the posterior part of the abdomen, with the inferior faces of the thighs, are of a bright salmon-red. I obtained it the entire length of the valley of the Warner Lakes, but not at Fort Bidwell. I have found it to range as far as the eastern foot of the Rocky Mountains in Montana;[1] and the specimens assigned by me[2] to *Rana septentrionalis*, from the Yellowstone Basin, may be the variety described above from Salt Lake City. I do not now have them before me for decision. Specimens of this species are in the National Museum, from Puget's Sound (Dr. Kennerly, No. 5975 a) and from "Camp Moryie" (Dr. Kennerly, No. 5973). The first-named specimens are accompanied by the *R. temporaria aurora*. It habits are aquatic.

Phrynosoma douglassi Bell. Var.

On the elevated land which represents the Sierra Nevada Range, between Warner's Lake and Goose Lake, in the basaltic region, near the former, I found a peculiar variety of this species. The horns are even more rudimental than in the usual form, but are all represented. The prominent scales of the back are smaller and less prominent. In some of the specimens the head is shorter relatively to the body. The color is an ironrust-brown, with darker lateral spots, each with a small posterior yellow border.

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[1] American Naturalist, 1879, p. 435.

[2] Annual Report U. S. Geol. Survey Terrs., 1871, p. 469.

Individuals are abundant; some of those taken are full of eggs. All are much smaller than the true *P. douglassi*.

Uta stansburiana B. and G.

Abundant on the crags of basalt on the sides of Warner's Valley. It is also common at Summer Lake, which is the most northern locality for the species and genus.

Sceloporus graciosus B. and G.

This very pretty species extends as far north as Summer Lake, and is quite abundant.

Sceloporus smaragdinus Cope.

Common as far north as Summer Lake. A specimen taken there has large torquoise-blue spots behind each brown cross-bar, on each side of the dorsal region.

Charina plumbea Bd. and Gird.

I found a single specimen of this curious snake in the road along the west side of Summer Lake. Although living, its muscles were alternately contracted in such a way as to give it the appearance of a knotted root. It was very tame, allowing itself to be handled without offering resistance. In life the inferior surfaces are of a rich yellow.

Pityophis mexicanus bellona B. and G.

From Summer Lake.

Bascanium vetustum B. and G.

Common in Warner's Valley, at Summer Lake and at Klamath Lake.

Eutænia pickeringii B. and G.

Very common everywhere near water, in all parts of the Lake country.

Eutænia sirtalis sirtalis Linn.

This species accompanies the preceding at Warner's third Lake, at Summer Lake and at Goose Lake, and retains its distinctive features. The specimens seen at Goose Lake have the bands brighter yellow than usual, and are very pugnacious. They preferred fighting to escaping, and bit furiously.

Eutænia sirtalis elegans B. and G.

Abundant. In young specimens the dorsal spots are distinct.

Eutænia biscutata sp. nov.

This is one of the best defined species of the genus. I have only two specimens, which agree in the following characters.

They differ in the number of rows of scales, however, one having twenty-three and the other twenty-two. All the rows of scales keeled, the median ones very strongly. Labials eight, the eye resting on the fourth and fifth. Two preoculars; three postoculars. The muzzle is rather short, the frontal plate exceeding in length the region anterior to it, and equaling the common suture of the parietal scuta. Nasals rather short; loreal as long as high; inferior preocular nearly square; superior preocular not reaching frontal. Superior labials all truncate above and none of them elevated, the sixth touching the inferior postorbital. Temporals, 1 · 2 · 3; the anterior are rather large. Pairs of geneials subequal. Gastrosteges, 156; urosteges, 79.

Color everywhere black, except on the chin and throat, and on the inferior side of the tail. The former was reddish in life. There are very faint traces of stripes on the third and fourth, and on the median dorsal rows of scales. No traces of spots on the parietal scuta.

Total length, m. 0·265; length to canthus of mouth (axial), ·012; length of tail, ·062.

This species is one of the best characterized of the genus. Its leading peculiarities are: first, the two preocular scuta; second, its twenty-three rows of scales. In both respects it is unique in the genus. Its color is characteristic. Its place is nearest the *E. radix* B. and G., with which it agrees in its rather robust proportions, and the position of the lateral stripe.

This species is not uncommon in the swamp vegetation on the borders of the lake. The specimens I took displayed little activity.

Crotalus confluentus lucifer B. and G.

This species is abundant at Warner's second Lake, and I took one at Silver Lake. The specimens are identical with those from near Pyramid Lake, Nevada.

11. The Willamet Valley, Oregon.

The fauna of this valley is that of western Oregon, and may be expected to differ from that of central and eastern Oregon. The climate of the Willamet Valley is very wet, and the soil is densely covered with forests. This is a state of things almost exactly the reverse of what obtains in central Oregon. Appropriately we have numerous species of salamanders and fewer

lizards than in the latter region. This collection was made by my friend, Professor O. B. Johnson, at that time residing at Salem. The specimens were obtained at various points between that city and Portland, north of it.

Amblystoma tenebrosum Bd.

Amblystoma macrodactylum Bd.

Plethodon intermedius Bd.

Cynops torosus Esch.

Bufo halophilus B. and G.

Hyla regilla B. and G.

Eumeces skiltonianus Bd.

Gerrhonotus multicarinatus Blv.

Sceloporus undulatus thayeri B. and G.

Phrynosoma douglassi Bell.

Charina plumbea B. and G.

Diadophis punctatus pulchellus B. and G.

Bascanium vetustum B. and G.

Eutænia leptocephala B. and G.

Of three specimens, two exhibit only seventeen rows of scales. These probably represent the supposed species *E. cooperi*, which is therefore not distinct.

Eutænia concinna Hallow.

I took a specimen of this beautiful snake at Eugene City, south of Salem. Not only the lateral vertical bars, but the muzzle, lips and gular region are a brilliant red.

12. Northern California.

The species referred to in this list were found near the United States fish-hatching establishment on the McCloud River, in Shasta County. I desire here to express my indebtedness to Mr. Livingston Stone, superintendent of the hatching station, for the hospitality which he extended to me at the time of my visit there.

Amblystoma (?) tenebrosum B. and G.

A large siredon from a small tributary of the McCloud is probably this species. It has peculiarities of the branchial structure, and I describe it by comparison with those found in other genera of American salamanders. These are mostly derived from specimens placed in my hands by the Smithsonian Institution, to which my acknowledgments are due. The coloration which appears in the

larger larvæ of the present collection, approaches nearest that of the *Amblystoma tenebrosum*. These animals were abundant in the small stream I examined, and swam with great rapidity, darting about and hiding themselves among the fallen leaves that covered the bottom.

I. Processes with two rows of rami:

Rami with many thread-like fimbriæ; *Siren.*

II. Processes with one—an outer—row of rami; processes horizontal.

A rudimental inner row of rami; fimbriæ thread-like; *Proteus.*

III. No principal rami;

A. Processes compressed; fimbriæ dependent from lower edge;

Fimbriæ thread-like, extending on both outer and inner face of process; *Necturus.*

Fimbriæ flat, long, chiefly confined to the lower margin of process; Larvæ of *Spelerpes ruber; S. bilineatus*, and *Gyrinophilus porphyriticus.*

Fimbriæ few, subclavate; *Plethodon cinereus.*

AA. Processes long, narrow; bearing fimbriæ only on the side next the body;

Fimbriæ simple, flat, sub-equal;. *Amblystoma.*

AAA. No processes nor rami; fimbriæ on the vertical septa.

Fimbriæ in numerous rows on the edge of the septa; slender, unbranched; *Larva of Amblystoma tenebrosum.*

AAAA. Processes vertical septa, with rami on the anterior edge;

Rami bearing flat, thread-like fimbriæ, which arise from the processes posteriorly and are often divided. *Larva from Simiahmoo, Washington Terr.*

Plethodon iëcanus sp. nov.

This salamander resembles the *Plethodon glutinosus* in various respects, especially in coloration. It has, however, a compressed tail like the *P. intermedius*, and short series of vomerine teeth.

The vomerine series are straight, and do not quite meet on the middle line. They are entirely behind the nares, and do not extend exterior to them. The parasphenoid patches are united into one, and are well separated from the vomerines.

Form rather stout, and the tail short, equaling (from vent) the

length of the body (with vent) to the gular fold. Costal folds 13. Head a longitudinal oval, with rather narrowed, and not truncate muzzle; its length (to occiput) contained three and two-third times in length from muzzle to groin.

Limbs short; when pressed along the side they are separated by three intercostal spaces. The digits are short, and the internal ones are rudimental.

The color is black everywhere, and the superior surfaces are dusted over with minute light specks.

Measurements.	M.
Total length,	·053
Length from muzzle to axilla,	·0105
Length from muzzle to groin,	·0275
Width of head at canthus oris,	·006
Length of anterior limb,	·006
Length of anterior foot,	·002
Length of posterior limb,	·0075
Length of posterior foot,	·0032

This species is to be compared with the *Plethodon intermedius* of western Oregon. It is shorter and more robust in form, having only thirteen costal plicæ instead of fifteen.[1] The color is very different.

This species is named from the aboriginal name Iĕka, of the grand peak of northern California, Mount Shasta. From the same name the town of Yreka derives its name. So I am informed by Judge Roseborough of that place, to whom I am under great obligations for many facilities and much information.

Cynops torosus Esch. *Diemyctylus torosus* Cope, Check List, Batr. Rept., N. Amer.

Bufo halophilus Bd. and Gird.

Hyla regilla B. and G.

The typical form.

Rana pachyderma sp. nov.

Represented by five specimens of different ages and sizes from

[1] On page 99, Proc. Phila. Academy, 1869, in my monograph of the *Plethodontidæ* the number of plicæ is given at 13. This is a misprint for 15. On p. 209, Proceedings for 1867, the number is correctly given as 15.

the McCloud River, and by two specimens from Ashland at the northern base of the Siskiyou Mountains, Oregon.

This species belongs to the *Rana temporaria* group, and must be compared with *Rana temporaria aurora* B. and G., and *R. pretiosa* B. and G. The vomerine teeth are opposite the posterior border of the choanæ, and form two short, transverse series. The toes are webbed to the base of the terminal phalange of the fourth digit. The hind-leg extended reaches the extremity of the muzzle with the heel. There are two plantar tubercles. The internal is narrow, rather prominent and with obtuse extremity; the other is at the base of the fourth metatarsal bone, and is rounded.

The muzzle is obtuse and the head rather wide. Its greatest width at the position of the membranum tympani, equals the length from the end of the muzzle to the line connecting the axillæ in some specimens; in others to that connecting the middle of the humeri. The skin is on all the superior surfaces thick and glandular. This condition is especially marked in the dorso-lateral fold of each side, which is so thickened in front as to resemble a parotoid gland. This becomes less visible in alcohol. The tympanic membrane is either entirely concealed, or is represented by a depression only. The skin covering it is roughened. A groove extends downwards and backwards from it. Between this and the canthus oris is a glandular thickening, and behind it are two others, one above the other. Posterior to these on the sides is a succession of rounded, roughened warts, similar to those of the toads. Similar warts, but less prominent, are scattered over the dorsal region, and are numerous near the extremity of the coccyx. The skin of the superior surfaces of the head, body and limbs is minutely but very distinctly roughened by small warts, each of which gives exit to a pore. Inferior surfaces smooth. Length of fingers beginning with the shortest, 2 · 1 · 4 · 3.

The color is dark brown or nearly black, with indistinct darker spots on the back; sides brown. Axilla and groin yellow, marbled with black. Thighs above light or dark brown, with three darker crossbars. Tibiæ similar, with three crossbars. Thighs behind, black, coarsely vermiculated with yellow, or yellow closely spotted with black. Below light yellow, spotted with brown on the gular region and on front of femora.

Measurements.

	M.
Length of head and body to vent, ...	·066
Length from muzzle to axilla (axial), . . .	·030
Length from muzzle to groin (axial), . . .	·054
Length of anterior leg, ...	·043
Length of manus, ...	·019
Length of posterior leg, ...	·117
Length of femur, ...	·033
Length of tibia, ...	·038
Length of tarsus, ...	·018

The specimens from Ashland agree with those from the McCloud, except that they are nearly black above and do not exhibit the dorsal spots.

I compare this species with the *Rana temporaria aurora* from the Russian River near the coast of California. That species has but one palmar tubercle, the internal, which is of similar proportions to that of the *R. pachyderma.* The skin is not thickened, and is much less glandular everywhere. The membranum tympani is entirely distinct. The posterior face of the femur is not vermiculated with yellow, but is covered with large, black masses. The whole of the under surfaces are brown-spotted. There are four brown crossbars on the tibia: traces of the fourth sometimes appear in the *R. pachyderma.* From *Rana pretiosa* it differs in all these characters; besides those that belong to the latter, *i. e.*, the posteriorly-placed vomerine teeth and the short hind-legs.

Eumeces skiltonianus B. and G.

Gerrhonotus multicarinatus Blv.

The movements of this species are not nearly so active as are those of the *Iguanidæ* and especially of the *Lacertidæ.*

Sceloporus undulatus thayeri B. and G.

Diadophis punctatus pulchellus B. and G.

Different from the typical form of the subspecies in having no spots on the inferior surfaces. I did not admit this form as distinct in my check list, but it had best be retained. It differs from the subspecies *amabilis* in having the inferior two rows of scales unicolor with the abdomen. In life this is a brilliant orange.[1]

[1] At this locality I found, under bark of logs, numerous specimens of *Brachycybe lecontei* Wood. This beautiful myriapod was originally described

13. Mouth of Russian River, California.

This locality is one hundred miles north of San Francisco. The collection was made by myself, in and on the border of the great redwood forest which there covers the hills and mountains of the coast range.

Batrachoseps attenuatus Esch. Abundant.

Plethodon oregonensis Gird.

Abundant, and especially pleasing from its liquid, prominent eyes. Always under the redwoods.

Cynops torosus Esch.

Abundant. This species is entirely aquatic.

Rana temporaria aurora B. and G. *Rana draytoni* B. and G. *Rana longipes* Hallow.

Not distinguishable as a species, in my opinion, from the *Rana temporaria* of the palæarctic realm.

Gerrhonotus multicarinatus Blv.

Eutænia sirtalis elegans B. and G.

14. Los Angeles, California.

Two collections from this locality are before me. One of these was made by Mr. DeCorse, Hospital Steward, at Drum Barracks, and was sent to the Smithsonian Institution. Prof. Baird submitted it to me for determination. The second collection was given me by Mr. Horatio N. Rust, the archæologist, who made it at Passadena, a short distance from the city.

Cynops torosus Esch. Rust.

Batrachoseps attenuatus Esch. Rust.

Phrynosoma blainvillii Gray. DeCorse.

Sceloporus undulatus thayeri B. and G. Rust.

Uta stansburiana B. and G.

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as from California, where it was supposed to have been collected by Dr. J. L. Leconte. I, however, subsequently obtained it from East Tennessee, and as Dr. Leconte had collected it in Georgia, it was supposed by Dr. Wood that the locality California was an error. Its rediscovery on the McCloud River shows that this species is found on the Pacific coast, as originally stated by Wood, and that it ranges over the width of the continent. In like manner a myriapod which I sent Mr. Ryder from the Russian River, is stated by him to be much like *Andrognathus* Cope, a genus heretofore known from the Alleghenies of Virginia.

Specimens remarkably large, and with the postinguinal black spot unusually large and distinct. DeCorse.

Gerrhonotus multicarinatus Blv. Rust.

Eumeces skiltonianus Bd. Rust, DeCorse.

Ophibolus getulus boylii B. and G. Rust.

Pityophis catenifer Blv. Rust, DeCorse.

Bascanium testaceum Say. Rust, DeCorse.

Eutænia hammondi Kenn. DeCorse.

Note on a Species of Xantusia.

The species described below was found by Dr. J. G. Cooper, Zoölogist of the State Geological Survey of California, and was placed in the collections of the University of California, where I saw it. It was kindly lent me for examination by the authorities of the University. The locality from which the specimen was derived is unknown, beyond that it is Californian.

Xantusia riversiana Cope. American Naturalist, 1879, p. 801.

The position of this genus in the system has been discussed by M. Bocourt[1] and myself.[2] I associated it with the genera *Lepidophyma* Dum., and *Cricosaura* Peters, and stated that I was not able to distinguish them from the family *Lacertidæ*. M. Bocourt places these genera in the family "Trachydermi," which also includes *Heloderma* Wiegm. This family is divided by M. Bocourt into two subfamilies, the *Glyphodonti* for *Heloderma*, and the *Aglyphodonti* for the three genera named, together with *Xenosaurus* Pet. Previously to this[3] I had examined and compared the osteology of *Heloderma* and *Xenosaurus*. On account of the differences in the form of the mesosternum, and in some other points, I regarded *Xenosaurus* as the type of a peculiar family to be placed with the *Helodermidæ* in the tribe Diploglossa. *Xantusia*, *Lepidophyma* and *Cricosaura* are, on the other hand, not Diploglossa, but are *Leptoglossa*. They are allied to the *Lacertidæ*, and especially to the Asiatic *Ophiops*, which is, like them, without eyelids. The character of the tongue is like that of the *Ecpleopidæ*, uniformly squamous, and has no resemblance to that of the *Diploglossa*. The characters of the scapular arch are those of the *Leptoglossa*. The clavicle is loop-shaped proximally, and the

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[1] Mision Scientifique de Mexique, Herpetology, p. 308, 1878.

[2] Proceedings of the Academy of Philadelphia, 1864, p. 229.

[3] Loc. cit. 1866, p. 322.

mesosternum is cruciform in *Lepidophyma* and *Xantusia*. I have not been able to examine *Cricosaura* as to these points. In my paper first mentioned, I stated that these genera have distinct parietal bones. I think that they should, on this account, be distinguished from the *Lacertidæ*, where they are coössified. Whether they are distinct or united in the Ecpleopidæ, I do not know, but the absence of eyelids will separate the group from that family. I use for it the name first given by Baird,[1] *Xantusidæ*, and characterize the three genera as follows:—

I. A large interfrontonasal plate; frontoparietals meeting on the middle line.

Superciliary scales none; pupil round; *Lepidophyma.*
Superciliary scales present; pupil vertical; *Xantusia.*

II. Two interfrontonasals; frontoparietals separated by interparietal.

Superciliary scales; *Cricosaura.*

All of these genera have femoral pores, and an exposed membranum tympani.

The species which has given occasion for the above discussion is the second one of the genus. It is several times as large as the type *X. vigilis* Baird, and has a different coloration. The digits are shorter.

The scales of the dorsal and lateral regions are rather coarsely and uniformly granular. The abdominal scales are quadrate, and are in sixteen longitudinal and thirty-two transverse rows. The preanal scales are in three transverse rows, the anterior two of four scales, with the median pair in both much enlarged, and the posterior row of six scales. Scales of the gular region flat and hexagonal, one row on the gular fold a little larger, and equal to the anterior gulars. Scales of the anterior aspects of the fore-leg and femur larger than the others; those of the tibia small, and those of the posterior face of the femur still smaller. Scales of the tail in whorls of equal width. The scales of equal size, and all convex in cross-section but not keeled. None of the scales of the body or limbs keeled.

The nostril is situated in a small scute at the junction of the sutures which separate the internasal, rostral, first labial, and first

[1] Proceedings Academy Philadelphia, 1858, December.

loreal scuta. Three loreals, increasing in size posteriorly. A circle of scales surrounds the eye, of which the superior or superciliary are the largest. The latter are separated by one row of scales from the parietal, supraorbital and frontal on each side. The interfrontonasal is nearly square. The frontonasals are considerably in contact. The frontal is hexagonal, and is broader than long. The interparietal is as large as each parietal. It is longer than wide, and notches the contact of the frontoparietals. The occipitals are large and quadrate. A single large temporal bounds the parietals and occipital, and it is followed by two small scuta which are in contact with the occipital. There are eight scales on the upper lip. Of these the fifth is the largest, and is part of an annulus which begins with two small scales at the posterior loreal, and terminates at the seventh scale, opposite the middle of the pupil posteriorly. The posterior labials are small, and are separated by nine rows of still smaller scales from the large temporal. No large auricular scales. The eye is rather large and its diameter is contained in the length of muzzle in front of it 1·75 times. The vertical diameter of the auricular meatus is a little less.

The first digits of both extremities are very short. The second of the pes is very little longer than the fifth. All the ungues are acute and are moderately curved. The hind-legs are remarkably short, not exceeding the fore-legs. Extended forwards the extremity of the fourth digit reaches the elbow of the appressed fore-leg. Femoral pores twelve on each side; no anal pores. The tail is not long, and its form is compressed with a flat inferior surface. The section is a triangle, higher than wide, with the apex narrowly truncate.

The color is light brown, with dark umber-brown spots on the superior surface. These spots form, in general, one median and two lateral rows, but as their forms are very irregular this order is obscure. The median dorsal are the largest, and they send branches laterally and anteroposteriorly, so that the result is rather confused. Dark brown bands cross the muzzle on the frontonasal plates and on the frontal, and form a wide U from the frontoparietals passing around the posterior edge of the occipitals. Sides of head with rather large brown spots. Inferior surfaces with minute brown spots which are least numerous on the middle line. Tail with irregular pale spots.

Measurements.	M.
Total length,	·118
Length to posterior edge of occipital plates,	·0162
Length to axilla,	·029
Length to groin,	·055
Length to vent,	·060
Width between orbits above,	·007
Width at temples,	·0115
Length of fore-limb,	·017
Length of manus,	·008
Length of hind-limb,	·023
Length of pes,	·011
Length of tibia,	·007

15. San Diego, California.

My friend, James S. Lippincott, made a collection of reptiles and batrachians at this locality, which throws considerable light on some points of geographical distribution. A catalogue of the species is here given:—

Bufo columbiensis Bd. and Gird.

A single specimen with smoother skin than the more northern forms. Gland on the surface of the tibia very distinct.

Spea hammondi B. and G.

See *antea*, page 14. Four specimens.

Eumeces skiltonianus Baird.

A specimen with the scales of the dark bands pale centered, and with a very thick tail.

Verticaria hyperythra Cope.

Cnemidophorus tessellatus tigris B. and G.

Aniella pulchra Gray.

Gerrhonotus multicarinatus Blv.

Uta stansburiana B. and G.

Crotaphytus wislizeni Bd. and Gird.

Phrynosoma blainvillei Gray.

Rhinochilus lecontei B. and G.

Hypsiglena ochrorhynchus Cope.

Bascanium testaceum Say.

General Observations.

The results to zoölogical geography obtained by the preceding identifications are as follows:—Collection No 1. The extension

northwards of the ranges of *Crotalus molossus* and *Stenostoma dulce.* No. 2. The extension northwards of the ranges of *Diadophis regalis*, *Crotalus lepidus* and *Holbrookia texana.* No. 4. The extension to the Rocky Mountains of the range of *Spea hammondi.* No. 6. The discovery of a new *Scaphiopus* in the Great Basin district; and of the southern extension of *Rana pretiosa* into the same. No. 7. The discovery that the Northern Pacific fauna extends east to the Rocky Mountains. This fauna is especially represented by *Bascanium vetustum*, *Rana pretiosa* and *Bufo columbiensis.* No. 8. The fact that the Great Basin district of the Sonoran fauna extends north to the southern slope of the Rocky Mountains in Idaho, where are found several of its species. These are *Phrynosoma platyrhinum*, *Crotaphytus wislizeni*, and *Uta stansburiana.* No. 9. The discovery that the same fauna extends north along the eastern slope of the Sierra Nevada to the beginning of Surprise Valley, California. No. 10. The determination that the Northern Pacific fauna extends from Surprise Valley, eastern California, northwards as far as my explorations have extended, viz., to Silver Lake and Klamath Lakes. No. 15. The determination of a wide southern range for *Spea hammondi* and *Bufo columbiensis*, and northern range for *Verticaria hyperythra.*

These results indicate that the Pacific region has a much greater extension eastward than it has been supposed to have, but which was foreshadowed in my paper on the Zoölogy of Montana, published in 1879.[1] They also indicate that it must be divided into three districts. These I call the Idaho, the Willamet, and the South Californian districts. The first is characterized by the absence of *Gerrhonotus* and *Cynops* and of certain species of *Amblystoma.* The South Californian is characterized by the presence of *Hypsiglena* and *Rhinochilus*, and absence of *Amblystoma.* It is allied to the Sonoran region, to which it is adjacent.

As regards the relation which the Sonoran region as a whole bears to the Nearctic and Neotropical realms, some remarks may be in place here. It is a question with some naturalists to which of the two it should be referred, and some would exclude it from the Nearctic without fully determining its relations to the Neotropical realm.

There can, however, be no doubt that it lacks all the peculiar

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[1] American Naturalist, p. 485.

features of the Neotropical realm, and if it lacks some of those of the Nearctic also, its types are mostly representative of the latter rather of the former. I content myself here with confirming this general principle by reference to the principal families and genera of cold-blooded vertebrata.

R. Nearctica.	R. Sonoriana.	R. Neotropicalia.
	PISCES.	
Salmonidæ.	Salmonidæ.	
Cyprinidæ.	Cyprinidæ.	Characinidæ.
Catostomidæ.	Catostomidæ.	
	BATRACHIA.	
Ranidæ.	Ranidæ.	
Scaphiopidæ.	Scaphiopidæ.	
		Cystignathidæ.
Amblystomidæ.	Amblystomidæ.	
	REPTILIA.	
	Lacertilia.	
Sceloporus.	Sceloporus.	Liocephalus.
Eumeces.	Eumeces.	Mabuia.
	Ophidia.	
		Bothrops.
Bascanium.	Bascanium.	Drymobius.
Tropidonotus.	Tropidonotus.	Helicops.
Eutænia.	Eutænia.	
Pityophis.	Pityophis.	
Diadophis.	Diadophis.	Rhadinæa.
		Coniophanes.
Ophibolus.	Ophibolus.	Erythrolamprus.
		Pliocercus.
		Oxyrrhopus.
		Sibon.
		Leptognathus.
		Boa.
		Xiphosoma.
	Stenostoma.	Stenostoma.

There are a good many genera which are found in the Sonoran district, which do not occur in other parts of the Nearctic realm. These genera are frequently confined to it, but when they are not,

they are to be looked for in the Mexican region of the Neotropical realm. I give a list of these genera, with a corresponding one of the Mexican region, to illustrate the extent of the similarity between the two regions.

R. Sonoriana.		R. Mexicana.
	PISCES.	
Plagopterinæ.		
	REPTILIA.	
	Lacertilia.	
Heloderma.		Heloderma.
Crotaphytus.		
Uta.		
Uma.		
Callisaurus.		
	Ophidia.	
Gyalopium.		Ficimia.
Phimothyra.		Phimothyra.
Trimorphodon.		Trimorphodon.
Hypsiglena.		Hypsiglena.

It seems then that the Neotropical relationships of the Sonoran region are not great. In this consideration I have omitted the genera which are common to the Mexican region and the Nearctic realm in general. Such are *Ranidæ*, *Cnemidophorus*, *Sceloporus*, *Bascanium*, *Tropidonotus*, *Eutænia*, *Pityophis*, *Spilotes*, *Ophibolus* and *Elaps*. These forms serve to indicate the affinity between the Nearctic realm and the Mexican region. The line between the two is, however, not yet exactly drawn. The former extends on the west coast at least as far south as Guaymas, and on the plateau as far as Guanajuato. On the east coast the Neotropical fauna reaches near to the Rio Grande. See On the Zoölogical Position of Texas, by the writer, in Bulletin U. S. National Museum, No. 20, August, 1880; and Eleventh Contribution to the Herpetology of Tropical America, by E. D. Cope, Proceedings Amer. Philosoph. Society, 1879, p. 267.

JANUARY 23.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

Ovipositing of Argynnis cybele.—Mr. H. SKINNER remarked that he had noticed a female of *Argynnis cybele* acting as though it were ovipositing, and seeing that it behaved in a peculiar manner, he was led to watch its proceedings carefully. Instead of attaching or cementing its eggs to the plant on which the young or larvæ are destined to feed, which is the usual habit of butterflies and moths, it hovered about a foot in height over a bed of violets, and at intervals would remain stationary and drop an egg from this distance to the food plant below. This seemed a remarkable procedure, inasmuch as it differed from the method which has been found to be so constant in this order. It remains to be seen whether this species always drops it eggs from a height, or only behaves in the peculiar manner occasionally while ovipositing. Also whether the other species of the genus *Argynnis* lay their eggs in a like manner. He thought it quite likely that *A. myrina* and *A. bellona* do so occasionally, as they differ from the other butterflies in the readiness with which they lay their eggs. He had known them to oviposit in chip boxes or other receptacles in which they were confined. He knew of no other species which behave thus. It had been stated that the species of the genus feed only on violets, which was probably not the case.

The following, received through the Botanical Section, was ordered to be printed :—

ON QUERCUS DURANDII Buckley.

BY CHARLES MOHR.

The rediscovery of this fine tree in Alabama adds now definitely another one to the number of oaks known to inhabit the forests east of the Mississippi River. First discovered by Prof. Buckley in 1841 in Wilcox County, Alabama, it was described from specimens collected near Austin, Texas, twenty years afterwards. I had occasion to study the tree in several localities in its western home during my investigations of the forest growth of southwestern Texas, in December, 1880; subsequently I directed my attention to its rediscovery in the eastern Gulf region, and particularly in Alabama. After a fruitless search through three seasons, I was finally rewarded at the close of the one just passed, in finding this oak in the woods covering the limestone ridges bordering the Little Cahabe River in Bibb County, Alabama.

The largest of the trees observed measured 2 feet in diameter by an estimated height of about 70 feet. The trunk divides at a height from 30 to 35 feet above the ground; the heavy primary limbs are erect, tall, and the head of the tree is of an oblong shape; it resembles in the habit of growth greatly the white oak: the bark is close, more so than in the Texan tree, where it is found inclined to be somewhat flaky, of a bright, almost pure white color, by which it is at once distinguished from the latter. There is scarcely a tree which shows greater variation in the size and shape of its leaves, which were at the date of its rediscovery, 11th November, for the greatest part shed. Only on some late, vigorous shoots, was the foliage yet fresh and green found to persist. The leaves are short petioled, from 2 to 3½ inches in length, and from ½ to 2½ inches at their greatest width, always attenuated at the base. They are either roundish, ovate or obovate towards the apex, largely dilated, irregularly and obtusely, more or less deeply three-lobed, or narrowed to lanceolate with shallow, distant lobes, a mere wavy or entire margin. Of a firm texture, the leaves are pubescent along the veins beneath when older, with a fine, close, pale tomentum.

The fruit is of annual maturation and (at least during this season) produced in abundance, short peduncled to sessile, single, in pairs or in clusters of three and four; small, from three-eighths

to five-eighths of an inch long. The nut is perfectly smooth, shining, of a light tan-color, ovate, somewhat narrowed towards the base, with the apex slightly compressed and umbonate to about one-third of its length, immersed in a shallow cup with closely appressed, slight, knobby and smoothish scales. The nut is sweet and regarded as the best of mast. The acorns seem to germinate in situations more or less exposed to light; the large trees are in more open situations found surrounded by their numerous offspring in all stages of growth.

From the limited knowledge we possess, but little can be said of the distribution of this oak. So far as known, it is confined to a calcareous soil, be it on the rocky uplands or in the bottom lands, the soil of which in western Texas consists of a fine calcareous silt. It seems not to occur west of the basin of the Colorado River; it was not found near New Braunfels or around San Antonio; on the dry, rocky hills near Austin, it scarcely reaches the dimensions of a middle-sized tree; in the rich bottom of the lower Guadeloupe it attains the proportion of the larger trees of the forest; there a number of trees were measured and found from 2 to fully 3 feet in diameter. One felled to the ground measured 37 inches through and 86 feet in length, being perfectly sound. In such localities most favorable to its development, it is esteemed as the most valuable of the timber trees; in its quality equal to the best of white oak timber, it enters into all the manifold uses to which the latter is applied, and which render the white oak of such great importance.

As far as known, the tree has not been found in eastern Texas, Louisiana, Mississippi, and the northern part of Alabama. In the latter State it seems in its northern extension confined to the southern edge of the silurian limestone formation at the 33° of latitude, at an elevation not exceeding 250 or 300 feet above the Gulf of Mexico. In reply to several inquiries made since, in regard to its occurrence in the central and lower part of the State, where the tree is called "Bastard Oak," it has become evident that it is not rare southward throughout the cretaceous belt on the rocky banks lining the water courses, to the tertiary limestone hills below. Its absence in the extensive territory between the latter and the calcareous hills on the Colorado River, nearly 700 miles to the westward, can be accounted for by the prevailing sandy or argillaceous soils quite destitute of lime, whose presence seems to be a necessary requirement for its growth.

JANUARY 30.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

The following papers were presented for publication:—

"Urnatella gracilis," by Joseph Leidy, M. D.

"On the Extinct Peccaries of North America," by Joseph Leidy, M. D.

"The Terrestrial Mollusca inhabiting the Society Islands," by Andrew Garrett.

The death of John Wister, a member, was announced.

Hybrid Birds.—CHAS. TOWNSEND referred to the rare occurrence of hybridity among N. Am. *Passeres*, and stated that two species of native warblers had recently been found to be hybrids, between species of the genus *Helminthophaga*. He exhibited a bird taken by Mr. W. L. Baily in Dec., 1882, near Haverford College, Pa., which proved to be a hybrid between the Snowbird and the White-throated Sparrow, birds of different genera, which was more remarkable.

After referring to the marks of hybrid origin borne by some doubtful species, handed down by the earlier ornithologists, he remarked that hybridity would doubtless be found a sufficient explanation for many obscure species that are standing puzzles to the ornithologists of to-day.

Mr. Chas. Morris was elected a member of the Council, to fill the vacancy caused by the election of Dr. Ruschenberger as Curator.

The following were elected members:—

F. A. Genth, Jr., Clarence R. Claghorn, G. Howard Parker, John B. Deaver, M. D., Wm. L. Springs, H. T. Cresson, Jacob L. Wortman and Emily G. Hunt.

FEBRUARY 6.

The President, Dr. LEIDY, in the chair.

Twenty-three persons present.

A paper entitled "A new Extinct Genus of Sirenia," by Edw. D. Cope, was presented for publication.

On a supposed Human Implement from the Gravel at Philadelphia.—Professor H. CARVILL LEWIS stated that through the kindness of Mr. John Sartain, the well-known engraver of this city, a supposed stone implement had come into his hands, which, from the circumstances in which it was found, becomes of great interest. In digging a pit below the cellar of the house No. 728 Sansom Street, Philadelphia, after passing through regularly stratified layers of gravel and sand, a loose, clean "water gravel" was reached at a depth of 24 feet from the surface of the street. The grade of the street is here about 35 feet above the mean level of the Delaware River, and the depth of the drift deposits, as shown by an artesian-well boring at the Continental Hotel, a few hundred feet distant, is 45 feet, gneiss rock being reached at that depth. The drift deposits consist of the usual alternations of sand and gravel with occasional streaks of clay, the whole being horizontally stratified.

The specimen was found at a depth of 24 feet in a loose gravel, where water flowed freely, and lay beneath a series of horizontally stratified layers of gravel and clay, which were entirely undisturbed, and were as originally deposited. Mr. Sartain saw the specimen taken out and testifies as to the accuracy of the above statement.

The supposed implement is an oblong rectangle in shape, $16\frac{1}{2}$ inches in length, nearly 4 inches in width, and in thickness varying from $\frac{1}{2}$ inch at the edge to $1\frac{1}{2}$ inches at the centre. It is ground to a smooth cutting-edge at the two extremities. It is rectangular in section, the sides forming right-angles with the faces. The sides are parallel with each other, but the faces are undulating surfaces, on one of which is a prominent longitudinal ridge, an inch and a half in width.

Each end of the implement appears to have been smoothly ground to form a square, even cutting-edge, an equal amount of grinding having been done on either side. Both extremities are similar. The implement is as unusual in shape as it is in size. It is double the length of ordinary celts, and was possibly a lapstone of some kind.

The late Professor Haldeman, who examined the specimen, expressed great interest in it, and pronounced it undoubtedly of human workmanship.[1]

[1] Mr. E. A. Barber, a well-known archæologist, reports, after a close examination of the implement, as follows:—"The peculiar marking or *pecking* shows it to be undoubtedly artificial. This pecking is characteristic of many pestles and other heavy stone implements found in this part of the country. There are certain small surfaces (the sides and part of the face) which have not been worked, but the greater part of the implement has been artificially pecked, and the ends have been ground down by abrasion, as may distinctly be seen. The character and use of the implement are not indicated by its shape, but there is no doubt at all as to its artificial workmanship."

Professor Lewis was not prepared to express such a positive opinion as to its artificial origin. The straight, parallel sides of the specimen, resemble the form of natural cleavage fragments of some sandstones and flagstones. Such cleavage fragments are frequently harder in the centre than along the edges, this being the result of a concretionary force, and if the specimen has been shaped by subsequent water action, the harder central portion would resist action and form the ridge already described. The regular bevelling at each extremity would, however, be a very unusual form to be produced by natural erosive forces.

The implement, if such it be, would be the first that has been discovered in the Philadelphia gravel, and would become of great interest in its bearing upon the antiquity of man on the Delaware. The implements found by Dr. Abbott in the gravel at Trenton are of a much more rude type, being closely allied in shape with the palæolithic implements of the river drift of several European localities. They are never ground down to an edge like the specimen now described, but are rudely chipped. The Trenton implements, moreover, are made from Triassic argillite, while this one is made from a compact yellowish-brown sandstone.

As the speaker had endeavored to show in a former communication,[1] the Trenton gravel is a post-glacial deposit made at the time of the final disappearance of glaciers from the headwaters of the Delaware, while the Philadelphia red gravel is somewhat older, having been formed during the glacial epoch at a time when this region was depressed 150–180 feet lower than its present level. Both gravels are true river gravels.

From the geographical position of the locality where the implement was found, it is probable that it belongs to the older of the two gravels. As, however, Professor Lewis had not seen the gravel at this place, judgment was reserved upon this point.

It would, indeed, be a curious fact if it were proved that an implement of neolithic type belonged to a gravel older than that which contained only palæolithic implements.

Should the specimen under consideration really belong to the gravel, and be proved to be artificial, it will carry back the antiquity of man to glacial times—an antiquity already assigned by numerous discoveries elsewhere. Unlike as this is to the palæolithic implements of Trenton, it is by no means the first neolithic implement reported from a river gravel.

Mr. John Ford[2] has discovered a polished stone axe in the gravel forming the outer bluff of the Mississippi River, near Alton, Ill., which is of great interest. This axe, now in the archæological collection of the Academy, was taken by Mr. Ford from a perpendicular face of gravel freshly cut and exposed by a road cutting; and, accompanied by a number of fossil land and

[1] Proc. Acad. Nat. Sc. (Min. and Geol. Section), Nov. 24, 1879.

[2] Proc. Acad. Nat. Sc. Phila., 1877, p. 305.

fresh-water shells of Quaternary age, a bone of *Canis*, and a specimen of lignite, lay at a depth of twenty feet in the gravel, and at an elevation of 50 feet above the river. Mr. Ford states that "the wall referred to presented in every part a solid front, without fissure or crevice, everywhere hard and impenetrable except by pick or crowbar, and yet twenty feet under the surface, within this strong matrix deposited by water thousands of years ago, laid the evidence of the presence of the man of the period, a stone axe artistically made, and doubtless used for the purposes of battle." The implement thus found by Mr. Ford is more finely finished than that from the Philadelphia gravel. It is made of hard syenite.

The implements said to occur in the auriferous gravels of California, described by Professor Whitney and others, and those from the loess of the Missouri Valley in Nebraska, discovered by Professor Aughey, are also of neolithic type, the California implements being as perfect as anything now made.

It may be, therefore, that in America rudeness of workmanship is not necessarily associated with great antiquity.

Opportunity is here taken to refer to a recent paper by Professor H W. Haynes,[1] entitled "Some indications of an early race of men in New England," in which the author describes some rough fragments of granite and quartzite found in various localities in Massachusetts, Vermont, and New Hampshire, which he considers to be rude forms of implements, more primitive than those of the Delaware gravels, and which are therefore to be regarded as relics of primeval man.

These objects are of various shapes, sometimes pointed, sometimes with sharp edges all around, and frequently sharp on one side and irregular on the other. These latter were regarded as implements adapted for being held in the hand for use in chopping or cutting. All these forms are of ruder type and coarser fabric than the implements of the Trenton gravel. They were found at localities where none of the ordinary traces of Indian occupation could be discovered, and the author infers from them the former existence in New England of a race of men different from and less advanced than the Indians.

With characteristic courtesy, Professor Haynes invited the speaker to make a personal examination of his full collection of these interesting objects.

A careful study of each specimen convinced Professor Lewis that the angularity of these rock fragments, while often resembling that of artificial forms, is in reality due to natural causes rather than to any human workmanship. Cleavage and frost-fracture and weathering planes appear to have been the sole agents in the production of the greater part of these forms. Upon most of the specimens examined, Professor Lewis was able to detect traces of

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[1] Proc. Bost. Soc. Nat. Hist., xxi, p. 382, Feb. 1, 1882.

the original cleavage or weathering planes parallel to certain sides of the fragment, which clearly indicated their mode of formation. Similar fragments occur in almost every portion of the country, their shape varying with the material of which they are formed. Professor Haynes himself states in the paper referred to, "Wherever it has been in my power to make the long and laborious search that is required, I have succeeded in finding them," etc. It is readily understood how a skilled archæologist, accustomed to find a use for every rude implement, would naturally find design also in the close imitations made by Nature.

Among these objects of natural origin there were also a very few which bore traces of human handiwork, some of these being apparently "skin-scrapers." These latter often occur with the most highly finished Indian arrow-heads, and offer, therefore, no evidence of high antiquity. The cases where the same Indian tribe has manufactured implements of the finest workmanship at the same time with those of rudest make, each being intended for different uses, are so numerous as to need only to be mentioned.[1]

Returning finally to the supposed implement from the Philadelphia gravel, now brought before the attention of the Academy, Professor Lewis stated that he did not desire to urge any one interpretation of it, but merely to offer some particulars which might not otherwise see the light, and to show their meaning if verified hereafter. Whatever value might be attached to the circumstances of the discovery of this specimen or to its apparent artificial origin, it would at least serve to stimulate a further search for evidences of man in the gravels underlying the city.

An implement found in a thickly populated district, more especially as it occurred in a shifting water gravel, would always be open to suspicion, and at all events a single specimen is not sufficient upon which to base the broad conclusions which would otherwise be warranted.

Note on a Drilled Mall in the Haldeman Collection of Antiquities.—Mr. H. T. Cresson called attention to a large drilled mall or hammer-head of stone, from the Haldeman collection of antiquities. It was found at Peach Bottom, Lancaster County, Pennsylvania, in 1866, and weighs eight and three-quarter pounds. Most pre-historic hammer-heads or stone malls, consist of oval pebbles, small boulders of quartzite, granite, or other hard materials, which show modification by the hand of man, and have generally undergone more or less of pecking and polishing to bring them into a required shape. The mall exhibited did not possess any groove, but had a drilled hole for the insertion of a haft, which

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[1] At a meeting of the Academy held a week ago, Mr. Aubrey H. Smith presented two Indian implements picked up by himself on the shores of the Loyalsock Creek, Lycoming Co., Pa., where they lay side by side. One was a rudely chipped implement like those of the Trenton gravel, while the other was a delicately formed arrow-point.

is of rare occurrence in any form of axes or hammers belonging to our American Indians, except in the case of ceremonial weapons. The length of the haft-hole in this mall is four and a half inches; but its width of one inch, which in the drilling from either end toward the centre, narrows to half an inch, does not seem to be sufficient in comparison with its size to warrant the insertion of a handle; for this reason the speaker was inclined to believe that it was in an unfinished condition. Malls have been found in the ancient copper mines at Keeweenaw Point and Isle Royal in Lake Superior without grooves for hafting, and occasionally with double grooves. There are malls in use at present among the Sioux Indians for breaking bones and pounding pemmican, but these are firmly encased in raw hide, except that portion of the head used in striking. The occurrence of this kind of haft-hole, excepting as before stated in the ceremonial weapons, is not often seen, resembling in this respect some of the neolithic malls and hammers of the eastern continent.

FEBRUARY 13.

The President, DR. LEIDY, in the chair.

Thirty-three persons present.

The following papers were presented for publication :—

"A new Unio from Florida," by Berlin H. Wright.

"Notes on the Birds of Westmoreland Co., Penna.," by Chas. H. Townsend.

The Publication Committee reported in favor of publishing the following papers in the Journal of the Academy :—

"Urnatella gracilis," by Jos. Leidy, M. D.

"On the Extinct Peccaries of North America," by Jos. Leidy, M. D.

"The Terrestrial Mollusca inhabiting the Society Islands," by Andrew Garrett.

Change of Color in a Katydid.—Professor LEWIS recorded a curious instance of modification in color in the case of a katydid, where the normal light green tint had been replaced by a bright scarlet, the complementary color. The insect, which was found at Point Pleasant, N. J., differs in no way from the common katydid, *Cyrtophyllum concavum* Say, except in the unusual color.

On the Reproduction and Parasites of Anodonta fluviatilis.—Prof. LEIDY directed attention to a basketful of living fresh-water mussels, *Anodonta fluviatilis*, which were obtained for him through the kindness of Rev. Jesse Y. Burke, and are now placed at the

disposal of members who wish to have them. They are fine robust specimens, the larger ones measuring 6 inches in length by 3 inches in height and almost 2½ inches in thickness. They were obtained from a little pond occupying an old marl pit, near Clarksboro, Gloucester Co., N. J.

These mussels appear to be exceedingly prolific. The pregnant females have the branchial uteri, as they have been appropriately named by Dr. Isaac Lea, enormously distended with perfected embryos. These appear with a cinnamon-brown shell, having a conspicuous spinous tooth or hook to each valve, and are furnished with long byssal threads. Wishing to ascertain the proportionate amount of embryos, the following plan was adopted:—In an individual 6 inches long the soft parts were weighed and found to be 135·44 grammes. The branchial uteri weighed 64 grammes and the inner gills 7·34 grammes. Supposing the latter to be of the same weight as the outer gills, free from embryos, this weight subtracted would leave 56·66 grammes as that of the embryos, and 78·78 grammes as the weight of the rest of the animal. In another specimen in which the weight of the soft parts was 113·75 grammes, the branchial uteri weighed 45·5 grammes, and the inner gills 5·2 grammes. Subtracting the weight of these would leave 40·3 grammes as the weight of the embryos, and 73·45 grammes for the rest of the animal. In another specimen by weight, and counting, the embryos in a milligramme were estimated to be 1,280,000.

The mussels are infested with many water mites creeping about among the gills. The young of the same, in various stages, were observed imbedded in the mantle. The mite appears to be identical with the species *Atax ypsilophorus*, which is a parasite of the common mussel, *Anodonta cygnea*, of Europe. It was discovered and described just 100 years ago, under the name *Acarus ypsilophorus*, by Dr. Christophori Gottlieb Bonz (Nova Acta Phys. Med. Acad. C. L. C. Nat. Cur., Nuremberg, 1783, 52, Tab. I, figs. 1–4). It is described and figured by Pfeiffer, with the name of *Limnochares Anodontæ* (Naturg. deutscher land und süss-wasser Mollusken, 1821, Taf. I, fig. 12); by Dr. Karl Ernst v. Baer, under the name of *Hydrachne concharum* (Nova Acta, Bonn, 1826, 590, Taf. XXIX, fig. 19); by P. J. van Beneden (Mem. de l'Acad. R. des Sciences de Belgique, XXIV, 1850), and by Ed. Claparede (Zeits. f. wiss. Zoologie, 1868, 445).

Dr. Bonz's description, referring chiefly to the form, color and marking of the mite, applies to ours; and further he thought the description of the details, of Claparede, applies sufficiently well to the same.

The characters of our mite are briefly as follows:—

Body ovoid, black, with a sulphur-yellow median line, often more or less interrupted, forked in front, and ending in an angular spot behind. The yellow marking divides the black into a pair of lateral reniform spots and an anterior irregular lozenge spot. Sides brown, from the eggs shining through. Head gray, with

dumb-bell eye-spots. Limbs gray, translucent, with the chitinous investment bluish black, hirsute, ending in pairs of double falcate ungues. Terminal joint of the palps ,ending in three minute uncinate denticles. Anal plates of the females usually with about 18 to 22 acetabula to each. Length of body 1·375 to 1·75 mm., breadth 1·125 to 1·5 mm. Inhabits the branchiæ and mantle of *Anodonta fluviatilis.*

The colors depend mainly on the contents shining through the transparent chitinous investment, which under reflected light exhibits a bluish-black tint. Commonly the black color is intense; and in alcoholic specimens the whole body is black. In several individuals the black passed into a chocolate hue. Dr. Bonz describes the European mite as black, with the median dorsal mark pale yellow; Pfeiffer as red-brown with a citron-yellow mark, and Beneden says it shows a Y in white, from which it was named.

The number of acetabula to the anal plates is variable; in one mite he found 23 to each plate, in a second 22 to each, in a third 22 to one and 17 to the other, and in a fourth 18 to one and 17 to the other. Claparede gives from 15 to 20 as the number to each plate in the European mite.

The variations of our mite, from the characters given of the European mite, are such as occur among individuals of either, and he therefore saw nothing distinguishing ours as a different species. Claparede describes another mite which infests the European Unios, which he distinguishes under the name of *Atax Bonzi.* The speaker had also observed a different mite, infesting the common mussel, *Unio complanatus*, of the Delaware River; of this mite he exhibited a drawing made in November, 1854. He suspected it to be the *Atax Bonzi;* but the question can only be more positively answered after the examination of certain details, which he hoped soon to have the opportunity of making.

If our two parasitic mites are identical with those of European mussels, it not only makes it appear probable that they are of common origin, but renders it the more probable that this is likewise the case with their hosts, even if these are not regarded of the same species.

Professor LEIDY also exhibited a collection of body-lice, *Pediculus vestimenti*, from Jews of Odessa, Russia, presented by Dr. A. G. Stratton. They range in size from 1·25 to 3·875 mm. in length, and appear in no respect to differ from those found on natives of our own country.

The Ice of the Glacial Period.—Professor HEILPRIN, referring to the subject of glaciation, stated that in his opinion the vast sheet of ice which is generally supposed to have covered during the great ice age a considerable portion of the northern regions of the European and North American continents, could not have had its origin, as is maintained by most geologists, in a polar "ice-cap,"

since it may reasonably be doubted whether there could ever have been formed in the extreme North an accumulation of snow and ice of a magnitude sufficient to propel southward a glacier, with an estimated thickness of several thousands of feet, to a distance of hundreds of miles, and up mountain slopes to heights equaling five or six thousand feet. The magnitude (as to height) to which such a snow accumulation may attain, will be dependent upon two conditions—(1), the quantity of aqueous (snow) precipitation, and (2), the upper limit in the atmosphere reached by clouds. It is well known that clouds, as a rule, rise highest in the regions of highest temperature—the equatorial—where the vapor absorption by the atmosphere is greatest, and where the planes of aqueous condensation are most distantly removed from the earth's surface; and, likewise, they rise higher in summer than in winter. The minimum rise will necessarily be in the extreme North (or South), and during the period of greatest cold, or winter. High (discharge) clouds are a rarity in the polar regions, and consequently precipitation will be mainly restricted to a comparatively low atmospheric zone. Above this zone, which will mark the upper limit of the "ice-cap," there can be but little snow accumulation. As a matter of fact, the officers of various Arctic expeditions have repeatedly noted that the high mountain-crests and elevations in the far North were frequently devoid of a snow covering, and that there was but very little precipitation, even over the low lands, during the winter, heavy precipitations setting in only with the spring months. The highest snow-clad elevation in the region of greatest cold (the West), in Greenland, appears to be Washington Land, with an estimated height of six thousand feet, which gives rise to the great Humboldt Glacier. Although this peak is completely buried under a mantle of snow (of undetermined thickness, however), it may yet safely be doubted whether snow of any great thickness (*unless under a much warmer climate*), could accumulate on a summit of much greater elevation. If not, this elevation, in the opinion of the speaker, was entirely inadequate to account for the southward propulsion of a glacier to the extent required by geologists.

Professor Lewis remarked that notwithstanding the difficulties in a theoretical explanation, the fact of a great continuous glacier at the time of maximum glaciation seemed clearly indicated, at least in America, by the numerous observations recently made. He described the extent of the glacier in America, as indicated by its terminal moraine, and stated that the close similarity of its phenomena at distant portions of its southern edge indicated a continuous ice-sheet. The continuous motion of its upper portion is shown by the uniform direction of glacial striæ upon elevated points. Thus the S. W. direction of the striæ upon the mountain tops of N. E. Penna., was identical with that upon the Overlook Mountain of the Catskills, and of that upon the summits of the Laurentians of Canada. The striæ at lower elevations conformed more or less to the valleys, and did not indicate the general move-

ment of the ice. The thickness of the glacier increased northward, the rate of increase diminishing as its source is approached. This latter point has not heretofore been appreciated, although observed some time ago by Dr. Hayes in the case of the Greenland glacier.

Recent observations by the speaker in Pennsylvania had shown the glacier to be 800 feet thick at a point five miles north of its extreme southern edge, and 2000 feet thick at a point eight miles from its edge, while it was only about 3100 feet thick one hundred miles farther northeast, and about 5000 feet thick three hundred miles back from its edge. The amount of erosion caused by it upon rock surfaces was in some degree a measure of its thickness, being far greater in Canada, even upon the hard Laurentian granites of that region, than in Pennsylvania, where even soft and friable rocks were but slightly eroded.

The present thickness of the glacier in central Greenland was considered, and the magnitude of certain icebergs detached from it was given. A friend of the speaker had, within a few months, seen a floating iceberg near the coast of Newfoundland, which stood 800 feet above the water by measurement, and may have been therefore nearly a mile in depth. Dr. Hayes saw an iceberg aground in water nearly half a mile deep.

That the great glacier flowed up steep inclines was abundantly proven by recent observations of the speaker in Pennsylvania. He instanced the striæ covering the north flank of the Kittatinny Mountain, and a boulder of limestone perched on the summit which, within a distance of three miles, had been carried up 800 feet vertically.

Referring to a paper recently published by Mr. W. J. McGee, who found difficulties similar to those of Professor Heilprin in the assumption of a polar ice-cap of great thickness, and who imagined the glacier to increase by additions to its outer rim, the speaker held that the single fact of the transportation by the glacier of far-traveled boulders to its terminal moraine, was a fatal objection to any such hypothesis.

Nor did he believe that the hypothesis adopted by Professor Dana and others, of a great elevation of land in the North, was a probable one The facts now in the possession of geologists do not indicate such a great and local upheaval as required by that hypothesis.

An explanation, therefore, must still be sought for the southward flow of a continuous ice-sheet -- a flow in some regions up-hill. The action of gravity was certainly not sufficient. Even in the case of the downward flow of the steeply inclined Swiss glaciers, it had been shown that gravity was more than counterbalanced by friction of the sides and bottom, and that these glaciers moved by reason of an inherent moving power of the molecules of the ice. It was probable that similar action occurred in the great continental glacier.

He suggested, therefore, a hypothesis which, while preserving

the unity of the glacier, as indicated by observed facts, neither assumed an unreasonable land elevation in polar regions, nor required a thickness of ice so great as to be open to the objections of the last speaker.

He suggested that the ice-cap flowed south simply because it flowed toward a source of heat. Such flow does not depend upon gravity, but would occur in a nearly flat field of ice, and he thought that the ice need not to have been more than a few times its present thickness in Greenland to account for all existing phenomena upon the hypothesis now suggested.

Professor HEILPRIN maintained that we were unacquainted with any laws of glacial action which would account for the indiscriminate progression of an ice-sheet toward a source of heat. The molecular-expansion theory as applied to the glacial phenomena of the Alps, took no cognizance of the position of the heat power, but merely of that of least resistance (the direction of slope). As to the magnitude of icebergs, the height above water gave no positive indication as to the development (in depth) beneath the surface, since this would largely depend upon the form assumed by the berg. As a matter of fact, however, the highest bergs observed by Hayes and Nares in the northern regions, rose only about 300 ft. out of the water, a height somewhat exceeding the highest Antarctic bergs encountered by the "Challenger." We had, therefore, no indications of any extraordinary development of ice in Greenland.

Chalcedony containing Liquid.—Professor H. CARVILL LEWIS called attention to a geode of chalcedony from the Salto River, Uruguay, presented by Mr. S. R Colbroun, of the United States Navy. The specimen contained an unusual quantity of liquid—from two to three drachms; it was derived from an extensive basaltic formation of amygdaloid and black melaphyr, and was coated with a substance resembling asbestos. He described the method of formation of such hollow masses of mammillary chalcedony as being endogenous and referred to an interesting paper recently published by I. Anson and Parkhurst upon the artificial manufacture of chalcedony.

On the Flowering of the Stapelia.—At the meeting of the Botanical Section, February 12th, Mr. THOMAS MEEHAN exhibited specimens of *Stapelia bufonia* in various stages of growth, inflorescence and fruit, and pointed out that though there were axillary buds of more or less prominence at the base of what we had to call leaves, yet the flowers rarely proceeded from these, but from lateral accessory buds. When the axillary buds developed, they produced branches and not flowers. The lateral accessory buds usually developed into minute abortive flowers, with a membranous scale or bract in the place of the primary leaf. These observations were made on plants which had been planted in the open ground

during the summer and were repotted in the fall and replaced in a warm greenhouse. The branches commented on had grown since that time, and might be termed the second growth of the same season. When the plants were being potted, having more than were needed, one was thrown carelessly under the greenhouse stage, where it shriveled considerably, but retained some vital power, enough in fact to send down a few fibrous roots into the earth. It had shriveled so as to be reduced to about half its normal weight. Its behavior under these conditions had not been observed till a few days since this date, when an examination showed that the greater portion of the axillary buds had developed into minute flowers, as in the case of the accessory buds under the normal condition. Some of these, judging by their dry remains, had grown to nearly one-fourth the usual size of the normal flowers, though most of them were much smaller. In these cases no lateral accessory buds had been produced. A perfect flower from a healthy pot-plant was exhibited, but not more than two-thirds the size of those produced in the growth of the first part of the season when the plant was in the open air. Numbers had been produced during the winter from the accessory buds at the base of the secondary growths. One of these had borne a fine seed-vessel, which was also exhibited. No seed-vessels had followed the numerous stronger flowers produced by the plants in the open air during the summer.

In commenting on these facts, Mr. Meehan pointed out their harmony with others bearing on the relation between nutrition and the various phases of the vegetative and reproductive conditions of vegetation. Morphologically every development from the bud to the fruit is primarily the same. We imagine all these developments to be founded on a primary leaf or leaves. Just when and how the various stages of development are brought about it is for physiology to determine. The student of fruit and forest trees knows that a rapid-growing young tree does not flower, and often when it commenced to flower, no fruit followed. Its vegetative vigor had to be somewhat checked before the reproductive forces induced flowers. The gardener brings about this condition by root-pruning or ringing, that is, taking off a portion of the bark of the vigorous tree. Transplanting often makes a barren tree fruitful. What would have been leaves, become petals and parts of fructification in the transplanted tree. He had himself placed on record many illustrations of this. The *Wistaria* and other climbing plants might flower, but rarely produce fruit when growing vigorously over trees or trellises, but as soon as branches were thrown off which could not attach themselves to supports, these lost their vigor, and the flowers produced seeds. But even when seeds resulted from the flowers of the *Wistaria*, they were rarely from the most vigorous at the commencement of the raceme, but only after the weaker flowers had been reached By a careful count, in many hundred cases he had found that in

racemes of the *Wistaria* which had produced seed-vessels, some forty or fifty flowers, on the average, faded before one produced seed.

These observations on *Stapelia* were of a similar character. The axillary buds, in the normal condition of the plant, resulted in branches only, the flowers proceeding only from the weaker lateral accessory ones. But when the vegetative powers of the plant are weakened, the axillary buds become flowering ones. The rarity with which seed-vessels are produced by the *Stapelia* under cultivation, he thought, might possibly be traced to some cause relating to nutrition, rather than to matters connected with pollination.

The observations were made solely on these winter-growing plants, as illustrated by the specimens exhibited; how far they might be paralleled by open air growth during the summer, the speaker could not say.

The following paper was ordered to be printed:—

ON A NEW EXTINCT GENUS OF SIRENIA, FROM SOUTH CAROLINA.

BY E. D. COPE.

Mr. Gabriel Manigault, the accomplished director of the Museum of the University of South Carolina, at Charleston, has placed in my hands for determination an interesting fossil of that region. It is the greater part of the right premaxillary bone of a large sirenian mammal, containing the large incisor tooth or tusk characteristic of the genus *Halitherium*. It, however, exhibits the peculiarity of possessing, exterior to this tusk, a second large tooth, which is probably also an incisor. This character distinguishes the form generically from other members of the order. In *Prorastomus* Owen, there are an inferior incisor and a canine not of sirenian type, but probably no superior incisors, or if present, they are minute and conic. I propose that the genus be named *Dioplotherium*. The only form with which it is necessary to compare it is *Hemicaulodon* Cope,[1] the number of whose incisor teeth is unknown. The one from which the genus is known, has a dense external sheath of cementum, which is wanting from the present genus.

The color of the specimen indicates that it belongs to the blue-gray marl of the Carolinian (Heilprin) miocene of our Atlantic region. It has, however, been exposed to the action of the water of a later sea, as it carries the bases of several *Balani*.

The premaxillary bone differs from that of the *Halitherium minor* Cuv. (*H. serresi* Gerv.) and *H. capgrandi* Lart., in the much shorter symphysis. The nareal border is also shorter, judging from the position of the maxillary suture, which is further anterior than in the species named. The nareal border is rounded and thickened, so as to overhang its lateral face at the maxillary suture. The alveolus of the second incisor is large, and is in close proximity to that of the first. Its posterior wall is lost. Its fundus reaches to the maxillopremaxillary suture, but as its anterior wall is entirely premaxillary, the tooth is probably an incisor, and not a canine.

The anterior incisor is a tusk of flattened form, with a slight taper from base to apex, and a narrow diamond-shaped section.

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[1] Proceedings Amer. Philos. Soc., 1869, p. 190.

Two end-sides of the diamond which present anteriorly, are shorter and more divergent than the posterior two. The latter encloses a wedge-shaped space, with an obtuse apex. Thus the posterior edge of the tooth is narrow and rounded. Of the anterior lateral angles the external is the more prominent. The tusk is gently curved outwards, and the posterior lateral face is also concave in anteroposterior section. The pulp cavity enters the crown for two-fifths of its length. The latter is composed of uniform dentine, and there are no traces of cementum or enamel. There are transverse bands of several delicate rugæ each, separated by considerable spaces. I count eleven from apex to base. The tooth is also obsoletely longitudinally striate, but cannot be called sulcate on the external face. On the internal face the longitudinal concave face is divided into a narrower and wider portion by a longitudinal ridge which marks the middle of the shaft. The triturating surface is narrow, and presents obliquely backwards. The projection of the crown beyond the alveolar border is not more than one-fourth the total length of the tooth.

The second incisor tooth is lost. Its alveolus shows that its form was less compressed than that of the first. While its size is considerable, it is evidently less developed than the first. Its anterior border slightly overlaps the posterior narrow edge of the anterior tooth.

Measurements.			M.
Vertical depth of premaxillary at septum between I. 1, and I. 2,			·128
Length of ditto at middle of side,			·118
Length of symphysis,			·126
Length of first incisor,			·176
Diameters do. at base	anteroposterior,		·050
	transverse	anteriorly,	·027
		posteriorly,	·011
Diameters do. at ·02 m. from apex,	anteroposterior,		·037
	transverse	anteriorly,	·020
		posteriorly,	·007
Projection of do. beyond alveolus (about),			·053
Transverse diameter of alveolus of I. 2, anteriorly,			·025

This species may be called *Dioplotherium manigaulti*, in honor of Mr. Manigault, to whom the University of South Carolina owes the present admirable condition of its Museum. The typical

specimen was found in or on the Wando River, northeast of the city of Charleston.

This genus furnishes a first step in tracing backwards the phylogeny of the *Sirenia*. These animals doubtless present the same phenomenon as that witnessed in the series of the Rhinoceroses, Ruminants, and some others, viz., a gradual reduction in number, and final extinction of the superior incisor teeth. In *Rhytina* the extinction is complete; in *Halicore* one remains. *Dioplotherium* with two, forms the passage to the primitive types, not yet known, which possessed three. They are considerably specialized in the present genus, and a reduction of size is to be looked for in the first ancestral genera of the *Sirenia*.

From the proportions of the parts preserved, the *Dioplotherium manigaulti* was rather larger than a dugong.

A portion of a Sirenian pelvis said to have been procured from the same locality, Wando River, was given me by Mr. Jacob Geismar. It resembles considerably that of *Halitherium*. A portion of the ischium and pelvis is broken away, so that it is not easy to determine positively whether there is an obturator foramen or not. Their bases are, however, united for a considerable distance beyond the acetabulum, and form a wide plate. The ilium is a stout rod, expanding a little towards the crest, which is broken away. The sacral articular surface is in two planes, one the inner side, the other the posterior edge of the bone, and are strongly impressed. The section of the shaft is subtriangular. The acetabulum is small, has raised edges, and an irregular *fossa ligamenti teris* notching its superior border.

Measurements.

Length from acetabulum to sacral face, exclusive,		·052
Width acetabulum,		·027
Diameter shaft ilium,	anteroposterior,	·018
	transverse,	·015

FEBRUARY 20.

The President, Dr. LEIDY, in the chair.

Forty-nine persons present.

The death of B. Howard Rand, M. D., a member, was announced.

Notes on Prehistoric Copper Implements.—Mr. H. T. CRESSON made some remarks upon a hammer of native copper found in the Bohemian Mine, at Greenland, Michigan, in 1866, by Mr. S. F. Peck, and now in the Academy's collection. It exhibits a distinct laminar surface, caused by hammering pieces of native copper together while in a cold state, a process in which our aborigines living in districts north of Mexico, seemed to have acquired great proficiency. This is shown by the numerous wedges, chisels, hammers, and other articles found in the ancient mining-pits at Keewenaw Point, Lake Superior, and at Isle Royal, together with axes, spear- and arrow-points, ornaments, etc., in Ohio, and throughout those sections of our country which at one time were inhabited by the mound-builders, a race of people whose remains indicate a state of advancement in the arts and manufactures superior to the savage nations who succeeded them. It is a very interesting fact, that recent discoveries have shown upon various forms of copper implements, deposited in their burial places by the mound-builders—markings similar to those left by moulds in the process of casting. It may, therefore, be supposed that these people were acquainted with the art of smelting, besides that of hammering copper. Professor Foster in his "Prehistoric Races of the United States," mentions the fact, that in a collection made by Mr. Perkins, he saw copper implements of mound origin, that bear well-defined traces of the mould. . . . "It is impossible," he adds, "to infer after a careful examination of these specimens, that the ridges have been left in the process of hammering or oxidation." . . . "The more I examine their arts and manufactures the stronger becomes my conviction that they were something more than a race of barbarian people." From these observations of Professor Foster, a skilful and cautious observer, it would appear that two processes were used, not only of hammering, but that of smelting, which latter process was in all probability suggested by their supposed method of extracting the masses of copper from their pits—remains of which may still be seen in the Lake Superior copper regions before mentioned. Some of these pits have been explored by Colonel Whittlesey, an account of which was published in the "Smithsonian Contributions to Knowledge for 1863." They were found to contain, in all cases, among the debris, fragments of charcoal and ashes, with traces of fires against the sides thereof, indicating the use of heat in the process of extracting their ores, thereby aiding the wedges and copper chisels which were driven in by means of stone mauls until

the desired pieces were detached. It may, therefore, be probable from the fact, that the melting point of copper is about 1000° C. to 1398°, there was sufficient heat generated by fires, used in above-mentioned method, to smelt the small points of copper attached to the larger masses, and that these people possessing the intelligence and quick perception of the Indian races, were led to notice and utilize it in smelting copper and casting their work. The artistic forms and finish of their copper implements, whether cast or hammered, cannot fail to impress the observer that a race of men existed in the early history of our continent, whose origin is enveloped in mystery, and whose skill rivals man of historic times, assisted by all the inventions of this mighty age of Iron.

The Tritubercular Type of Superior Molar Tooth.—Prof. COPE made some observations on the trituberculate type of superior molar tooth among the mammalia. He remarked that it is now apparent that the type of superior molar tooth which predominated during the Puerco epoch was triangular; that is, with two external, and one internal tubercles. Thus of forty-one species of Mammalia of which the superior molars are known, all but four have three tubercles of the crown, though of these thirty-seven triangular ones, those of three species of *Periptychus* have a small supplementary lobe on each side of the median principal inner tubercle.

This fact is important as indicating the mode of development of the various types of superior molar teeth, on which we have not heretofore had clear light. In the first place, this type of molar exists to-day only in the insectivorous and carnivorous Marsupialia; in the Insectivora, and the tubercular molars of such Carnivora as possess them (excepting the plantigrades). In the Ungulates the only later forms of it in the Eocene are to be found in the molars of the *Coryphodontidæ* of the Wasatch, and *Dinocerata* of the Bridger Eocènes. In later epochs it is chiefly seen only in the last superior molar.

It is also evident that the quadritubercular molar is derived from the tritubercular by the addition of a lobe of the inner part of a cingulum of the posterior base of the crown. Transitional states are seen in some of the *Periptychidæ* (*Anisonchus*) and in the sectorials of the *Procyonidæ*.

The Spinal Chord of Batrachia and Reptilia.—Dr. HARRISON ALLEN called attention to the characters furnished by the spinal chord in the systematic study of batrachians and reptiles. In making a resumé of the researches of Stieda Lüderitz, S. H. Gage and J. J. Mason he had formulated the following structural features which may be added to those characters already employed by systematists. In batrachians, as illustrated in *Rana*, *Menopoma* and *Siren* the connective is seen about the central canal to be of unusual development, and in *Siren* to embrace the entire chord in a conspicuous cortical layer. In addition to these features, connective-tissue corpuscles are sparsely distributed

through the chord when studied in transverse sections. The posterior columns are projected above the plane of the lateral columns and exhibit distinct differences in the arrangement of nerve-fibres. In lacertilians and crocodilians the commissures are perforated longitudinally by a pair of columns of nerve-fibres. In ophidians the posterior nerve-roots are seen to be rudimentary or absent and when present to tend to arise from the *cervix cornu* of the posterior horn of gray matter. In chelonians the motor-cells are few in number; the anterior median fissure is of great width, the commissure of relatively great size, and the reticular fibres lying to the lateral aspect of the gray columns are unusually well developed.

FEBRUARY 27.

The President, Dr. LEIDY, in the chair.

Thirty-seven persons present.

Walter Rogers Furness was elected a member.

On Dinodipsas and Causus.—Prof. COPE drew attention to a recent important discovery made by Prof. Peters, of Berlin, of the new genus of venomous snakes, *Dinodipsas*. He stated that he regarded the genus as pertaining to the *Causidæ*, a family he had proposed as a subfamily in his first paper read before the Academy in 1859. As the only genus heretofore known, *Causus*, is African, the statement of Peters that *Dinodipsas* is South American, adds an important fact to geographical zoölogy. Prof. Cope then corrected a statement made by Peters in his Herpetology of the Reise nach Mozambique (1882), that he (Prof. Cope) had referred *Causus* to the Vipers. In 1859 he had divided the venomous snakes with vertical and hinged maxillary bone, into the subdivisions of the rattlesnakes, the vipers, the Atractospidines and the Causines. He then designated the entire group Viperidæ after Bonaparte, and had not until later used Duméril and Bibron's term *Solenoglypha* for that division. But this did not justify Peters in stating that he had referred the genus *Causus* to the Vipers, and that he, Peters, was the author of the separate family to receive that genus and *Dinodipsas*, the "Vipernattern."

He also corrected some other references to himself by Prof. Peters in the Reise nach Mozambique. In one of these, Peters had supposed him to refer to a combination of the genera *Breviceps* and *Chelydobatrachus* by Peters, when he had really separated them. Prof. Cope said that his language referred to their union in the *same family* by Peters, which he did not approve.

Prof. Peters also states that the peculiarities of the tongue in the genus *Hemisus*, described by Steindachner and Prof. Cope, are due to mutilation. Prof. Cope could not coincide with this view, and regards the structures described as normal.

The following were ordered to be printed:—

A NEW UNIO FROM FLORIDA.

BY BERLIN H. WRIGHT.

Unio Cunninghami. Plate I, figs. 1-4.

Shell ovate, ventricose and very inequilateral, smooth, interrupted by numerous irregular, undulating lines of growth, causing a scaly appearance near the margins, and very highly polished above; substance of shell very thick, constricted posteriorly, angular behind and truncated before; ligament margin moderately arcuate and angular at the terminus (tip); posterior margin wedge-shaped and slightly acuminate; ligamental area elongately cordiform and wide, nearly forming a plane in old individuals; umbonal slope subangular from beak to margin; anterior margin angular above and somewhat abruptly rounded beneath; basal margin emarginate posteriorly in the males and uniformly curved in the females; epidermis usually dark chestnut or reddish brown, interspersed with marginal bands of light horn-color; occasionally the entire shell is of uniform light horn-color, wrinkled and entirely destitute of rays; greatest diameter near the middle of the umbos; beaks eroded and obtuse; umbo broad and flattened; nacre usually a delicate pink: occasionally white; cardinal and lateral teeth both single in the right and double in the left valve, lateral teeth short, slightly and uniformly curved and separated from the cardinal teeth by a space equal to one-half of their own length; cavity of the shell and beak both shallow; dorsal cicatrices five and situated above the centre of the cavity of the beak; distinct anterior and confluent posterior cicatrices; ventral cicatrix usually present and placed anterior to the centre of the cavity of the shell.

Habitat.—Lakes of Sumter County, Florida.

This beautiful shell belongs near *U. Buckleyi* Lea, from which it differs in being strictly rayless in all stages of its growth, greater diameter, more angular anteriorly above and more abruptly rounded beneath, broader and flatter umbos and more abrupt posterior slope. The cardinal teeth are much heavier and not as oblique as in *U. Buckleyi*. A large suite of the shells was sent to me by Mr. T. L. Cunningham, of Yalaha, Sumter County, Florida, in whose honor we name it.

Plate I, fig. 1, *Unio Cunninghami*, old male; 2, full-grown female; 3, old male; 4, young male.

NOTES ON THE BIRDS OF WESTMORELAND COUNTY, PENNA.

BY CHAS. H. TOWNSEND.

Local lists have added so much to our knowledge of the range and distribution of birds, that the following notes are submitted as a contribution to the general fund of information. The species enumerated represent perhaps not more than two-thirds of the actual bird fauna of Westmoreland County. Many more might probably be added, but I wish to restrict this list to those birds identified with certainty, and have given only such as have come under my personal notice, not having enjoyed the advantage of comparing notes with a fellow-naturalist.

No special effort was made to find new birds, and this catalogue, merely the result of observations jotted down from time to time in my note-book, is very incomplete. It is hoped that its present publication will call forth additional information, so that a supplemental paper may appear in the future.

Not having been a constant resident of the county since commencing to note the birds, I could not always collect at the most fruitful seasons, consequently a large number of migratory birds have escaped notice. The district being wooded and hilly, there are no very extensive marshes to harbor rail, snipe and other swamp-loving birds. I feel confident that the number of water-birds in general will hereafter be largely increased.

My rambles were mainly in the central portions of the county, along the Loyalhanna Creek, and in the vicinity of Latrobe, on the line of the Penna. R. R. The Chestnut Ridge, a range of the Alleghenies, extending through the S. E. part of Westmoreland, is covered with heavy forests, and furrowed by deep wild ravines. Many rare wood-birds doubtless lurk in these secluded spots, and remain to be discovered by any one diligent enough to make the search.

I may add that I have seldom taken a tramp through the forests of Chestnut Ridge without seeing or shooting one or more birds new to the region.

The species are arranged according to the second edition of Dr. Coues' Check List.

TURDIDÆ.

1. **Turdus migratorius.** Robin.
A common and familiar bird. Stragglers are occasionally seen in winter. Breeds abundantly.

2. **Turdus mustelinus.** Wood Thrush.
Common in dense woods. An excellent songster, but not equal to the Brown Thrush.

3. **Turdus fuscescens.** Wilson's Thrush.
Not very common.

4. **Turdus unalascæ nanus.** Hermit Thrush.
An inhabitant of retired woods.

5. **Mimus carolinensis.** Cat-bird.
An abundant summer resident; breeds.

6. **Harporhynchus rufus.** Brown Thrush.
Common; nests in thickets and brush-heaps.

SAXICOLIDÆ.

7. **Sialia sialis.** Blue-bird.
Common summer resident; nests freely in artificial bird-boxes near houses.

SYLVIIDÆ.

8. **Regulus calendula.** Ruby-crowned Kinglet.
This and the next species are frequent in spring and fall.

9. **Regulus satrapa.** Golden-crested Kinglet.

10. **Polioptila cœrulea.** Blue-gray Gnatcatcher.
Have taken but one specimen.

PARIDÆ.

11. **Lophophanes bicolor.** Tufted Titmouse.
Common; noticed oftener in winter than in summer.

12. **Parus atricapillus.** Black-capped Chickadee.
Associates with the last.

SITTIDÆ.

13. **Sitta carolinensis.** White-bellied Nut-hatch.
Resident, quite common. The Nut-hatches and smaller Woodpeckers are indifferently known as "sap-suckers" in this region.

14. **Sitta canadensis.** Red-bellied Nut-hatch.
Seen occasionally in spring.

CERTHIDÆ.

15. **Certhia familiaris.** Brown Creeper.
A shy inhabitant of the woods.

TROGLODYTIDÆ.

16. **Troglodytes domesticus.** House Wren.

Apparently not common. A pair nested on a beam in our cellar, in 1880, and remained with their brood until the latter part of July.

17. **Anorthura troglodytes hiemalis.** Winter Wren.

Resident; frequently seen in winter in ravines and thickets.

18. **Telmatodytes palustris.** Long-billed Marsh Wren.

Seldom seen; inhabits reedy swamps.

SYLVICOLIDÆ.

19. **Mniotilta varia.** Black-and-white Creeper.

Occasionally seen in summer.

20. **Dendrœca æstiva.** Summer Warbler.

Common in spring and summer.

21. **Dendrœca virens.** Black-throated Green Warbler.

Migratory.

22. **Dendrœca cœrulescens.** Black-throated Blue Warbler.

Migratory.

23. **Dendrœca coronata.** Yellow-rumped Warbler.

Migratory; common.

24. **Dendrœca blackburnæ.** Blackburn's Warbler.

Common during spring migrations.

25. **Dendrœca striata.** Black-poll Warbler.

Migratory.

26. **Dendrœca castanea.** Bay-breasted Warbler.

Saw several in the spring of 1881.

27. **Siurus auricapillus.** Golden-crowned Thrush.

Rather common in damp woods; remarkable for its oven-shaped nest on the ground.

28. **Siurus motacilla.** Large-billed Water Thrush.

Have seen it twice in a rocky ravine in Chestnut Ridge.

29. **Geothlypis trichas.** Maryland Yellow-throat.

Summer resident; common in briar patches and dense thickets.

30. **Myiodioctes canadensis.** Canadian Flycatching Warbler.

Migratory; taken but once.

31. **Setophaga ruticilla.** Redstart.

Not common.

TANAGRIDÆ.

32. **Pyranga rubra.** Scarlet Tanager.

Summer resident; common.

HIRUNDINIDÆ.

33. **Hirundo erythrogastra horreorum.** Barn Swallow.

Common.

34. **Petrochelidon lunifrons.** Cliff or Eave Swallow.

Breeds abundantly.

35. **Stelgidopteryx serripennis.** Rough-winged Swallow.

Have a single specimen, which I shot near Youngstown.

36. **Progne subis.** Purple Martin.

Very common; breeds freely in bird-houses in the villages.

AMPELIDÆ.

37. **Ampelis cedrorum.** Cedar Waxwing; Cherry-bird.

Quite common, especially when cherry-trees are in fruit.

VIREONIDÆ.

38. **Vireo olivaceus.** Red-eyed Greenlet.

Common in orchards and groves.

39. **Vireo solitarius.** Blue-headed Greenlet.

Apparently migratory.

LANIIDÆ.

40. **Lanius borealis.** Gt. Northern Shrike; Butcher-bird.

Very rare; I have seen it near Latrobe.

FRINGILLIDÆ.

41. **Passer domesticus.** House Sparrow; European Sparrow.

This irrepressible foreigner has established himself in our towns and villages, to the total exclusion of native songsters.

42. **Carpodacus purpureus.** Purple Finch.

Not common; have seen but few individuals, and those in spring. Probably only migratory here.

43. **Astragalinus tristis.** Am. Goldfinch; Thistle-bird.

Summer resident; abundant; breeds.

44. **Plectrophanes nivalis.** Snow Bunting.

One of my friends described to me a flock of birds which he saw flying about the fields during very severe weather in Jan., 1881, which, from his description, must have been Snow Buntings.

45. **Poœcetes gramineus.** Grass Finch.

Common; breeds.

46. **Melospiza palustris.** Swamp Sparrow.

Common.

47. **Melospiza fasciata.** Song Sparrow.

Common; breeds.

48. **Junco hiemalis.** Snow-bird.

Common in winter.

49. **Spizella monticola.** Tree Sparrow.

Common in winter.

50. **Spizella domestica.** Chipping Sparrow; Chippy.

Summer resident; very common, nesting in garden bushes.

51. **Spizella agrestis** Field Sparrow.

Common in summer.

52. **Zonotrichia albicollis.** White-throated Sparrow.

Not common.

53. **Zonotrichia leucophrys.** White-crowned Sparrow.

Not common.

54. **Passerella iliaca.** Fox Sparrow.

Rather rare; occasionally seen late in autumn.

55. **Zamelodia ludoviciana.** Rose-breasted Grosbeak.

Uncommon; have taken occasional specimens in midsummer in the forests of Chestnut Ridge.

56. **Passerina cyanea.** Indigo-bird.

Common summer resident.

57. **Cardinalis virginiana.** Cardinal Grosbeak; Red-bird.

Frequent both in summer and winter; have seen numbers of them in Chestnut Ridge, where they probably breed, as I have seen quite young birds there. One which I crippled by a shot in the wing, lived in a cage for more than a year and became an accomplished whistler.

58. **Pipilo erythrophthalmus.** Chewink; Ground Robin.

Common everywhere, in bushes and hedges.

ICTERIDÆ.

59. **Dolichonyx oryzivorus.** Bobolink.

Summer resident; gregarious in the fall migrations.

60. **Molothrus ater.** Cow-bird.

Very common in summer; I have seen its eggs in nests of the Indigo-bird and Chipping Sparrow.

61. **Agelæus phœniceus.** Red-winged Blackbird.

Breeds plentifully.

62. **Sturnella magna.** Meadow Lark.

Abundant; breeds regularly, gregarious in the fall. Have seen stragglers in midwinter.

63. **Icterus spurius.** Orchard Oriole.

Not common.

64. **Icterus galbula.** Baltimore Oriole; Hang-nest.

A familiar bird in summer. A pair nested regularly for several seasons in the same tree near our door.

65. **Scolecophagus ferrugineus.** Rusty Grackle.

Common.

66. **Quiscalus purpureus.** Crow Blackbird.

Common everywhere.

CORVIDÆ.

67. **Corvus corax.** Raven.

Old residents report a "crow" of very large size, as once common. It was doubtless the Raven.

68. **Corvus frugivorus.** Common Crow.

Breeds regularly.

69. **Cyanocitta cristata.** Blue Jay.

Resident throughout the year; common.

TYRANNIDÆ.

70. **Tyrannus carolinensis.** King-bird; "Bee-bird."

Summer resident; common; much persecuted by bee-keepers, who imagine it is destructive to bees.

71. **Myiarchus crinitus.** Gt. Crested Flycatcher.

Not as common as the last.

72. **Sayiornis fusca.** Pewee.

Very common; has nested under the eaves of our porch frequently.

73. **Contopus virens.** Wood Pewee.

Quite common in woodlands.

CAPRIMULGIDÆ.

74. **Antrostomus vociferus.** Whip-poor-will.

Common in summer; a bird often heard after nightfall, but seldom seen.

75. **Chordediles popetue.** Night-hawk.

Very common in summer; confounded with the last by many persons; but, unlike it, the Night-hawk soars high in the air; both species nest on the ground.

CYPSELIDÆ.

76. **Chætura pelasgica.** Chimney Swift.

Common; have seen numbers of them circling about tall chimneys, where they had nests.

TROCHILIDÆ.

77. **Trochilus colubris.** Ruby-throated Humming-bird.

Quite common; I once found a nest containing eggs, near Beatty Station, P. R. R.

ALCEDINIDÆ.

78. **Ceryle alcyon.** Belted Kingfisher.

Common; breeds regularly; have seen stragglers as late as Dec. 20, when all streams were frozen.

CUCULIDÆ.

79. **Coccygus erythrophthalmus.** Black-billed Cuckoo.

Common; breeds.

80. **Coccygus americanus.** Yellow-billed Cuckoo.

More common than the last; usually called Rain-bird by schoolboys.

PICIDÆ.

81. **Hylotomus pileatus.** Pileated Woodpecker.

Occasionally seen in heavy-timbered localities.

82. **Picus villosus.** Hairy Woodpecker.

Resident; common.

83. **Picus pubescens.** Downy Woodpecker.

Resident; quite common.

84. **Sphyropicus varius.** Yellow-bellied Woodpecker.

Apparently not common.

85. **Centurus carolinus.** Red-bellied Woodpecker.

Rather common.

86. **Melanerpes erythrocephalus.** Red headed Woodpecker.

Abundant.

87. **Colaptes auratus.** Flicker; Golden-winged Woodpecker.

Very common summer resident.

STRIGIDÆ.

88. **Bubo virginianus.** Gt. Horned Owl.

A common resident.

89. **Scops asio.** Screech Owl.

Resident, very common.

90. **Strix nebulosa.** Barred Owl.

Resident, common.

91. **Nyctea scandiaca.** Snowy Owl.

Very rare.

FALCONIDÆ.

92. **Accipiter fuscus.** Sharp-shinned Hawk; Pigeon Hawk.

Not as common as the next species.

93. **Accipiter cooperi.** Cooper's Hawk.

Common; have taken its nest.

94. **Falco sparverius.** Sparrow Hawk.

Very common; breeds.

95. **Buteo borealis.** Red-tailed Buzzard; Chicken Hawk.

Common; breeds.

96. **Buteo lineatus.** Red-shouldered Buzzard.

Rather common.

97. **Archibuteo lagopus sancti-johannis.** Am. Rough-legged Buzzard; Black Hawk.

Very rare. A specimen was shot near Latrobe, in the spring of 1879, by Mr. Edgar Chambers. If I remember rightly, the bird was perfectly black.

98. **Pandion haliaëtus.** Fish Hawk; Osprey.

Rare; I saw a specimen which was shot in the Loyalhanna Creek, near Latrobe, in 1879. Have seen specimens shot on the Allegheny River, at the N. W. boundary of Westmoreland Co.

99. **Haliaëtus leucocephalus.** Bald Eagle.

Occasional specimens have been taken. Fragments of one are in my possession.

CATHARTIDÆ.

100. **Cathartes aura.** Turkey Buzzard.

Very rare; formerly common, according to the statements of old residents. Have seen several in an adjoining county.

COLUMBIDÆ.

101. **Ectopistes migratorius.** Wild Pigeon.

Migratory; appears in immense flocks in some seasons.

102. **Zenaidura carolinensis.** Carolina Dove; "Turtle Dove."

Breeds regularly; abundant.

MELEAGRIDÆ.

103. **Meleagris gallipavo americana.** Wild Turkey.

Resident; no longer common; a few are killed in the mountains every year.

TETRAONIDÆ.

104. **Bonasa umbella.** Ruffled Grouse; "Pheasant."

A well-known game-bird; resident, common.

105. **Ortyx virginianus.** Quail; "Bob-white."

Resident, common; neither this nor the last species as abundant as in former years.

CHARADRIIDÆ.

106. **Ægialites vociferus.** Killdeer Plover.

Summer resident; abundant.

SCOLOPACIDÆ.

107. **Philohela minor.** Woodcock.

Common; have seen it as early as March 13.

108. **Gallinago wilsoni.** Snipe.

Summer resident.

109. **Tringoides macularius.** Spotted Sandpiper.

Common in summer; breeds.

ARDEIDÆ.

110. **Ardea herodias.** Gt. Blue Heron.

Migratory, occasional; have two specimens in my collection, shot on the Loyalhanna Creek.

111. **Herodias egretta.** Gt. White Egret.

Migratory; irregular.

112. **Butorides virescens.** Green Heron.

Quite common in summer; breeds.

113. **Botaurus mugitans.** Bittern.

Not common; have one specimen shot by Mr. J. C. Head, of Latrobe.

RALLIDÆ.

114. **Rallus virginianus.** Virginia Rail.

Summer visitant.

115. **Porzana carolina.** Carolina Rail: Sora.

Mr. G. N. Beckwith, of Latrobe, reports it common. Mr. G. H. Adams, agent of the P. R. R., gave me the only specimen I have seen in Westmoreland. It was found in a freight-car at Beatty Station.

116. **Fulica americana.** Coot; "Mud Hen."

Rather common.

ANATIDÆ.

117. **Cygnus columbianus.** Am. Swan.

Occasionally shot on the Loyalhanna Creek.

118. **Bernicla canadensis.** Wild Goose.

Migratory; rather common.

119. **Anas boscas** Mallard Duck.

Mr. G. N. Beckwith assures me of the occurrence of this and the next two species.

120. **Anas obscura.** Black Duck; Dusky Duck.

121. **Dafila acuta.** Pintail.

122. **Querquedula carolinensis.** Green-winged Teal.
Migratory.

123. **Querquedula discors.** Blue-winged Teal.
More frequent than the last.

124. **Aix sponsa.** Wood or Summer Duck.
Summer resident; breeds.

125. **Fuligula marila.** Scaup Duck; Black-head.
Migratory; usually abundant.

126. **Fuligula ferina americana.** Red-head; Pochard.
Probably migratory.

127. **Clangula albeola.** Buffle-head Duck; Butter-ball.
Migratory; common.

128. **Harelda glacialis.** Long-tailed Duck.
On February 5, 1881, Mr. Harry Chambers shot a male of this species, on the creek at Latrobe. It is the only instance of the occurrence of this maritime duck so far inland, so far as I am aware.

129. **Erismatura rubida.** Ruddy Duck.
Migratory; abundant in spring.

130. **Mergus merganser.** Goosander; Fish Duck.
Regularly migratory.

131. **Mergus serrator.** Red-breasted Merganser.
Migratory, occasional.

132. **Mergus cucullatus.** Hooded Merganser.
Irregularly migratory.

LARIDÆ.

133. **Larus delawarensis.** Ring-billed Gull.
I have a specimen, shot on the Loyalhanna Creek, May 7, 1881. Other species of gulls doubtless visit our streams during migration.

COLYMBIDÆ.

134. **Colymbus torquatus.** Loon; Gt. Northern Diver.
Migratory; a few are shot every season by the gunners.

PODICIPIDÆ.

135. **Podicipes cornutus.** Horned Grebe.
Rare; Mr. Harry Chambers gave me a specimen which he shot on the Loyalhanna Creek. This is the only instance of its occurrence that I can cite.

136. **Podilymbus podicipes.** Pied-billed Grebe; "Dipper."
Resident; well known to gunners everywhere.

MARCH 6.

Mr. GEO. W. TRYON, JR., in the chair.

Twenty-six persons present.

Permian Fishes and Reptiles.—Prof. COPE exhibited some specimens of fishes and reptiles from the Permian formation of Texas. One of these was a new species of Crossopterygian fish which he named *Ectosteorhachis ciceronius*, which exhibited some important characters of the posterior cranial region. He stated that the base of the skull consists of ossified parachordals, and these embrace the chordadorsalis posteriorly, and are continued for a short distance posteriorly as a tube. Anteriorly the chordal groove is open. Trabeculæ not ossified. He considered the cranial structure to be an excellent illustration of a permanent embryonic type.

The most interesting reptile was a new genus which occupies a place between the *Pelycosauria* with molar teeth, and those with raptorial teeth, but with more resemblance to the former, or *Diadectidæ*. The teeth are placed transversely in the jaws, but the crowns terminate in an incurved apex, without ledge. He named the genus *Chilonyx*, and referred it provisionally to the *Bolosauridæ*. The typical species is the *Bolosaurus rapidens* (Cope, 1878), an animal with a skull as large as that of a hog, and with robust limbs. The surface of the skull is divided by grooves into numerous swollen areas, and some of these are, on the lateral occipital region, developed into tuberosities like the rudimental horns of the *Phrynosoma douglassi*.

Phenomena of Glaciation.—Professor HEILPRIN, referring to his former communication on the phenomena of glaciation, stated that if the principles laid down by him as to the limitation (in height) of a polar ice-cap be correct, then the same principles must likewise hold good for all portions of the earth's surface. In other words, given an elevation of sufficient magnitude, then the upper portion of the same, by virtue of its rising above the cloud-line, must be either bare of snow or covered only with a comparatively feeble thickness of the same. This view, which the speaker believed was first enunciated by Humboldt, receives confirmation from observations made on the Alps and on other high mountain peaks. Thus, according to Tschudi, only a comparatively very feeble thickness of snow falls on the Alpine summits above an altitude of about 10,800 feet, the heavy precipitation being principally confined to a zone comprised between 7000 and 9000 feet. The brothers Schlagintweit determined the cumulus line in the

same region to lie at a general elevation of 8-9800 feet, above which storms were of only exceptional occurrence, and the atmosphere usually clear and serene. These observations as to feeble precipitation were further confirmed by Dollfuss, who found that on the Théodule Pass (10,800 feet) the total precipitation for the six winter months amounted to only 7½ feet of snow. On the St. Gothard, on the other hand, at an elevation almost exactly 4000 feet lower, nearly the same quantity fell in a single day. Again, on the Grimsel (6150 feet) Agassiz found the winter snow-fall to amount to 57½ feet. While, therefore, the highest Alpine summits generally appear to be buried in an almost unfathomable thickness of snow, there can be but little doubt that in actual fact this thickness is but very moderate. This is proved by the circumstance that under exceptional conditions the snow covering may almost completely disappear as a result of a single season's melting. Thus in September, 1842, the Ewigschneehorn was completely dismantled of its cap, and in 1860–1862 a whole series of the usually snow-clad peaks showed only patches of snow. During the same period the Stralech (11,000) feet could be crossed without the traveler encountering a single patch of either hard or soft snow (Reclus). With these facts before us, we have good grounds for doubting whether any extraordinary accumulation of snow, unless with a much warmer climate, could take place in the region of the far north (with a descending cloud line) on elevations of very great magnitude. Granting, however, the possibility of a huge polar glacier tending southward, some singular facts are brought out by a calculation of its rate of progression. Allowing an average rate of one foot per day, which is about that of the average Alpine glacier, it would necessitate for a glacier starting from about the sixty-fifth parallel of latitude a period of no less than 25,000 years for it to have reached the line of its terminal extension, the terminal moraine. But with such an infinitesimal slope as such a glacier must necessarily have had, it may be questioned whether its rate of progression would have been more than one-fifth or even one-tenth of that which has been here given it. At the average rate of two and one-half inches daily, 125,000 years would have been required for its southerly progression, a period that would nearly tide over the interval between the periods of greatest eccentricity indicated by astronomers.

Professor LEWIS remarked that arguments drawn from meteorological conditions as they now exist will not in all cases apply in considering the glacial epoch. The distribution of land and water was so different in glacial times that meteorological conditions must also have been different. He instanced facts which he had observed in the valley of the Delaware and elsewhere, indicating a depression south of the glaciated area, which produced a greater water surface in the glacial epoch, and therefore different meteorological conditions. He remarked also that it was unsafe to found arguments upon any close analogy between the conditions of local

glaciers or isolated peaks and the great ice sheet of the glacial epoch. While analogies might be drawn from the glacier of interior Greenland or from the Antarctic ice-cap, he thought that errors often arose from a too close comparison with more local centres of glaciation.

Referring to the subject of glacial motion, Professor LEWIS said that while there were not yet sufficient facts at hand to determine its rate, its general direction and continuity were clearly shown in the striæ on elevated summits. He spoke of the importance of distinguishing these high-level striæ from those occurring in valleys, remarking that erroneous conclusions had frequently been drawn from an examination of maps of striæ, where the relative elevation of the individual striæ was not noted. While the striæ upon mountain summits indicate the general direction of the top of the ice, and are uniform over large areas, those in valleys show merely the local movement of the lower strata, and, conforming more or less to the direction of the valley in which they occur, vary in each locality and are therefore of minor importance. As an instance he described some striæ near White Haven, Luzerne Co., Pa. Those in the valley of the Lehigh near the town bore S. 35° E. or approximately down the valley, while on the other hand, upon the summit of Penobscot Knob, 1100 feet higher than the valley (2250 feet above the sea), the striæ bore S. 10° W., this being the general direction of ice-flow across northeastern Pennsylvania. In all cases the striæ are at right-angles to the terminal moraine, and they therefore point S. E. in western Pennsylvania. He gave other facts which he had observed in Pennsylvania and elsewhere, all pointing to the continuity of action and consequent great size of the glacier. He spoke of the probable analogy between the Antarctic ice-cap, some 2500 miles in diameter, and the Polar ice-cap of glacial times, and mentioned Croll's estimate that the former is twelve miles thick at its centre. In speaking of a Polar ice-cap, he did not mean to imply, however, that the ice was necessarily thickest on the Pole. As in Europe the mountains of Scandinavia and Scotland were probable centres of glaciation, the glaciers from which joined to form the great *mer-de-glace*, so in America either Greenland, Labrador, the Hudson Bay region, or elsewhere, may have been centres from which glaciers grew finally to coalesce into one mass of ice, the top strata of which flowed southward to the great terminal moraine.

MARCH 13.

The President, Dr. LEIDY, in the chair.

Thirty-nine members present.

The death of Henry Seybert, a member, was announced.

A paper entitled "On the mutual relations of the Bunotherian Mammalia," by Edw. D. Cope, was presented for publication.

Crystallized Serpentine from Delaware.—Professor H. CARVILL LEWIS remarked that a short time ago, his venerable friend, Dr. Isaac Lea, had handed him for examination a specimen of Deweylite from Way's feldspar quarry, near Wilmington, Delaware, upon which were some crystals of an unknown micaceous substance.

The white, waxy deweylite, weathering to a pale yellow color on the surface, contains numerous angular fragments of transparent quartz, which vary in size from microscopic dimensions to fragments two inches long by one-half inch wide. In all cases these fragments are perfectly sharp and are generally rhomboidal in shape. These rhombic cleavage fragments are just such as would be produced by throwing a heated crystal of quartz into cold water. Under the microscope, the quartz is shown to contain hair-like microlites and minute oval cavities, the major axes of which are usually placed in one direction.[1]

The deweylite also contains irregular masses of feldspar (albite), which are more or less altered into deweylite. Unlike the fragments of quartz, these feldspar nodules are almost invariably rounded in outline, as though partially dissolved away. The feldspar has lost both its lustre and its hardness. It has a waxy appearance, and its hardness is reduced to 4·5. In some specimens one end is more altered than the other, and it is evident that the deweylite is the result of the alteration of albite.

The third mineral in the deweylite is in the form of plates or crystals of a micaceous substance of a pale smoky pearl color with a faint greenish tinge. The plates may be several inches in diameter, and are traversed by numerous joints or cracks filled with deweylite, which are generally inclined to one another at angles of 60° and 120°. The crystals appear to be sections of an orthorhombic crystal, bounded by six prismatic planes, whose angle of intersection is 120°. In the polariscope, the mineral is seen to be doubly refracting, and is biaxial with a small optic-axial divergence (probably between 10° and 20°), the hyperboles being indistinct.

It has a strong pearly lustre, an eminent basal cleavage, almost micaceous, and is brittle. It has a hardness of 2·5, and specific gravity of 2·41. It is translucent, and by transmitted light is grayish or greenish yellow.

In the closed tube it gives off water and decrepitates slightly, becoming blackish gray or dark steel-colored. In the blow-pipe flame it blackens, then turns white, exfoliates slightly, and fuses with boiling at 4·5 to a white bead. In the salt of phosphorus bead it dissolves completely to a clear glass which becomes milk-white in a cold saturated bead. With cobaltic nitrate on charcoal

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[1] *v.* Further notes on inclusions in gems Isaac Lea, Proc. Acad. Nat. Sc. Phila., May, 1876.

it turns pink. It is decomposed by hydrochloric or sulphuric acid without gelatinization.

At the request of Professor Lewis, Mr. Reuben Haines had made an analysis of the mineral with the following results:—

SiO_2	43·63
MgO	39·71
FeO	0·78
Al_2O_3	2·23
H_2O	13·20
	99·55

Mr. Haines determined the specific gravity in a specific gravity bottle containing a thermometer, the weighing being done at 60° F.

From the composition as well as from its physical characters the mineral appears to be a true serpentine. Its optical characters show that it is crystallized, and not a mere pseudomorph. If so, the crystallization of serpentine is micaceous, as already surmised by Professor Dana.[1]

As the deweylite is the result of the alteration of feldspar, so the serpentine has been altered from mica (muscovite). The relative amount of muscovite in the adjoining graphic granite is about the same as that of the micaceous serpentine in the deweylite. Moreover in certain specimens of feldspathic deweylite, where the feldspar is not completely altered, there occur crystals of hydro-muscovite (margarodite) in place of the micaceous serpentine.

Thus it is evident that the serpentine is changed from mica. Were it not for the ready cleavage and the special optical characters of the serpentine, it should be regarded merely as a pseudomorph. The occasional markings at angles of 120°, though scarce and imperfect, are in harmony with the same character belonging to several other micaceous species among the magnesian hydrous silicates, and indicate a close relationship between the serpentine group and the Vermiculite group of minerals.

It is interesting to find in the quartz, deweylite and serpentine, just described, such complete evidence that they have been derived from the direct alteration of graphic granite (pegmatite). While the albite and muscovite have changed into deweylite and serpentine respectively, the quartz has been broken up into cleavage fragments, and scattered through the deweylite. This fracturing of the quartz may, perhaps, give a clue to the method of alteration. As Hunt[2] has suggested, in an early period of geological history, when the earth's crust was hotter than now, and when a high temperature existed even at slight depths, thermal waters would abound and chemical changes would be rapid. Should such waters, highly charged with magnesian salts, come in contact with the heated

[1] System of Mineralogy, p. 465.

[2] Chem. and Geol. Essays, p. 306.

feldspathic rocks, there might result such a change as is here shown to have occurred. Certain facts which the speaker had observed in the serpentine deposits of Chester County, Penna., notably in Brinton's quarry, indicate that a change from a granitic dyke into serpentine is not an uncommon occurrence.

The two points of interest offered by the specimens here described are, 1. The crystallization of serpentine, as shown by its optical character; 2. The direct alteration of the feldspar and mica of graphic granite into the magnesian minerals, deweylite and serpentine, while the quartz has been fractured.

Contraction of Vegetable Tissues Under Frost.—At the last meeting of the Botanical Section, Mr. MEEHAN referred to a prevalent opinion that the liquid in vegetable tissues congealed as ordinary liquid does, and, expanding, often caused trees to burst with an explosive sound. Mr. Meehan made experiments with young and vigorous trees, varying from one foot to three feet in circumference. They were carefully measured in early winter when the thermometer was about 40°, and again after they had been exposed for many days to a temperature below freezing point, and, at the time of measurement, to 10° above zero.

In no case was there the slightest evidence of expansion, while in the case of a large maple (*Acer dasycarpum*), of 3 feet 11½ inches round, there appeared to be a contraction of ⅛ inch. This was the largest tree experimented with. In dead-wood soaked with water, there was an evident expansion; and the cleavage with explosion, noted in the case of forest trees in high northern regions, may result from the freezing of liquid in the centre or less vital parts of the trunks of trees.

In some hardy succulents, however, instead of expansion under frost, there was a marked contraction. The joints or sections of stem in *Opuntia Rafinesqui* and *O. Missouriensis*, shrink remarkably with the lowering of the temperature. As soon as the thermometer passes the freezing point, the shrinkage is so great that the whole surface has the wrinkled appearance presented by the face of some very aged person. A piece of *Opuntia Rafinesqui*, which in November measured 4 inches in length, is but 3½ now, and is not half the thickness it was in the autumn. In the winter when the thermometer was down to 10° above zero, the pen-knife penetrated the tissue just as easily as in summer, and no trace could be discovered of congelation in the juices of the plant. Other succulents exhibited more or less signs of shrinkage under extreme cold. *Mamillaria Nuttallii*, and *M. vivipara*, with *Echinocactus Simpsoni*, a mamillose form, drew the mammæ upwards, and had them appressed as closely as the spines would allow—and some species of *Sempervivum* did the same. This could only be accomplished by the contraction of the main axis from the apex downwards. *Sedum Hispanicum*, which has not a succulent axis, contracts its leaves into longitudinal wrinkles, pre-

senting the appearance of being withered or dead. They expand again in a few days of temperature above the freezing point. Specimens of this *Sedum*, and of *Opuntia Missouriensis*, preserved just above freezing point under glass, did not shrivel—and a plant of *Echinocactus Simpsoni*. taken under cover, after the mammæ had been appressed by frost, expanded them to its summer condition in a short time afterwards.

Assuming from these facts that the liquids in plants which are known to endure frost without injury, did not congeal, it might be a question as to what power they owed this successful resistance. It was probably a vital power, for the sap of plants, after it was drawn from the tree, congealed easily. In the large maple tree already referred to, the juice not solidified in the tree, exudes from the wounded portions of branches and then freezes, hanging as icicles often six inches long from the trees.

MARCH 20.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

Note on a New Gold-purple.—Dr. GEORGE A. KÖNIG stated that while experimenting with a solution containing

$Ca_2H_2As_2O_8$	=	5·242
$CaSO_4$	=	2·983
$CaCl_2$	=	4·890
$MgCl_2$	=	2·736
$AuCl_3$	=	0·112
H_3AsO_4	=	10·290
		26·163 grains per liter,

he observed that upon adding to it very slowly a solution of one part of crystallized ferrous sulphate in ten parts of water, stirring vigorously after each drop, at first a white turbidity formed which gradually assumed a very rich purple color. The flocculent precipitate settles completely in twenty-four hours, but may be collected on a filter at once. Sometimes the purple color develops gradually, requiring several hours, the precipitate being white for some time. This result obtains, when less ferrous salt is added than required. One cub. cent., containing $\frac{7}{100}$ milligr. of gold, of the above solution with $\frac{1}{10}$ cub. cent. of ferrous solution, developed a very fine precipitate. Sometimes the purple does not develop at all; the precipitate turns bluish gray and remains so.

This purple substance can be dried at 100° C. without change of color. Heated to red heat the pieces assume a glazed appearance and turn black; but the fine powder again shows a blue-purple

color. The purple obtained from 250 cub. cent. of the solution contained

As_2O_5	. .	= 0·0583 gram.
Fe_2O_3	. .	= 0·0340 "
Gold (Au)	. .	= 0·0188 "
$CaSO_4$	. .	= 0·0060 "

The only gold-purple heretofore known was the Purple of Cassius, obtained by adding a mixture of stannic and stannous chlorides to a dilute gold solution. Authors are divided in their opinions as to whether the gold is contained therein in the metallic state and only mechanically admixed as a red allotropic modification, or chemically combined as gold dioxide. The speaker has inclined hitherto to the first view, and finds in this *ferric arseniate gold-purple*, physically so very analagous to the stannic gold-purple, a strong support to the mechanical hypothesis. Dilute hydrochloric acid decomposes this purple at once into brown gold, and arsenico-ferric solution.

A Flint Nodule from the Greensand of New Jersey.—Prof. Leidy directed attention to a flint nodule, presented this evening, obtained from the greensand of Pemberton, N. J. It is discoid, about the size of a dollar, pitted and smooth, homogeneous and bluish black, and exhibits no trace of organic remains. He remarked that as flint nodules, regarded to be of organic origin, were so exceedingly abundant in the chalk formations of Europe, he had wondered that similar nodules were not of more frequent occurrence in the greensand deposits, of contemporary age, in our country. The nodule presented was the only one of the kind he had ever seen from the New Jersey marl.

March 27.

Mr. Geo. W. Tryon, Jr., in the chair.

Forty-five persons present.

April 3.

Rev. Dr. Henry C. McCook, Vice-President, in the chair.

Thirty-eight persons present.

A paper entitled "Aztec Music," by H. T. Cresson, was presented for publication.

The following was ordered to be printed:—

ON THE MUTUAL RELATIONS OF THE BUNOTHERIAN MAMMALIA.

BY E. D. COPE.

The name Bunotheria was proposed by me for a series of Mammalia which resemble in most technical characters the Edentata and the Rodentia. That is, they agree with these orders in having small, nearly smooth cerebral hemispheres, which leave the olfactory lobes and cerebellum entirely exposed, and in some instances the hemispheres do not cover the mesencephalum also. From the two orders in question, however, they are easily distinguished. Their enamel-covered teeth separate them from the Edentata, while the articulation of the lower jaw is different from that found in the Rodentia. It is a transverse ginglymus, with a postglenoid process in the *Bunotheria*, as distinguished from the longitudinal groove, permitting anteroposterior motion, of the Rodentia.

Such a group as is thus characterized will include two existing groups recognized as orders—the Prosimiæ and the Insectivora. The latter group has always been a crux to systematists, and when we consider the skeleton alone, as from the standpoint of the palæontologist, the difficulty is not diminished. Various extinct types discovered in latter years, chiefly in the Eocene formations, have been additions to this intermediate series of forms, giving even closer relations with the orders already adjacent; *i. e.*, the Edentata, the Rodentia, the Prosimiæ, and the Carnivora. As is known, the groups corresponding to these orders have been named respectively the Tæniodonta, Tillodonta, Mesodonta, and Creodonta. With great apparent diversity, these suborders show unmistakable gradations into each other and the two recent orders already mentioned. As such, I may mention *Psittacotherium*, which relates the Tæniodonta and Tillodonta; *Esthonyx*, which relates the Tillodonta with nearly all the other suborders; *Achænodon*, which connects Creodonta and Mesodonta, and *Cynodontomys*, which may be Mesodont or Prosimian. Then the existing *Chiromys* most certainly connects Tillodonta and Prosimiæ.

My original definitions of the suborders of the Mesodonta, given in vol. ii of the U. S. Geological Survey under Capt. G. M. Wheeler, p. 85, omitted the Prosimiæ, and embraced a number

of characters whose significance must be reëxamined. Thus it is impossible to characterize the Creodonta as lacking a trochlear groove of the astragalus, in view of the form of that element in *Mesonyx* and *Mioclænus*, where the groove is more or less distinct. It is impossible to distinguish the Insectivora from the Creodonta by the deficiency of canine and large development of incisor teeth. In *Rhynchocyon* the canines are large, and the superior incisors wanting, while in *Centetes* the arrangement of these teeth is precisely as in the Creodonta. As to the large *Achænodon* and other *Arctocyonidæ*, I find no characters whatever to distinguish them from the generally small Mesodonta.

In view of these inconsistencies, I have reëxamined the subject, and find the following definitions to be more nearly coincident with the natural boundaries of the divisions of this large order. The importance of the character of the tritubercular superior molar has recently impressed me (see Proceedings of the Academy, 1883, p. 56), as it had previously done Prof. Gill. This zoologist has already distinguished two divisions of the Insectivora (without the *Galeopithecidæ*), by the forms of the superior molar teeth. The first possesses quadritubercular molars above, the second tritubercular. That these types represent important stages in the development of the molar dentition I have no doubt. These characters far outweigh in importance those expressing the forms of the skull, matters of proportion only, with which a few systematists unnecessarily overload their diagnoses. Such characters are of little more than specific value, and serve to obscure the mind of the inquirer for a true analysis. They may be used empirically, it is true, to determine relationships when the diagnostic parts are wanting.

I propose to transfer the Insectivora with tritubercular superior molars to the Creodonta, in spite of the fact that some of them (*Mythomys*, *Solenodon*, *Chrysochloris*) have but weakly developed canine teeth, and *Chrysochloris* has large incisors. As an extreme form, *Esthonyx* will follow, standing next the Tillodonta. It will then be necessary to transfer the Arctocyonidæ and all the Mesodonta to the Insectivora, where they will find affinity with the *Tupæidæ*. These have well-developed canines and small incisors, as in the extinct groups named. The *Chiromyidæ* must be distinguished from all of the other suborders, on account of its rodent-like incisors, combined with its lemur-like feet.

The characters of the six suborders will then be as follows:

I. Incisor teeth growing from persistent pulps:

Canines also growing from less persistent pulps, agreeing with external incisors in having molariform crowns; I. *Tæniodonta.*

Canines rudimental or wanting; hallux not opposable; II. *Tillodonta.*

Canines none; hallux opposable; III. *Daubentonioidea.*

II. Incisor teeth not growing from persistent pulps:

Superior true molars quadrituberculate; hallux opposable; IV. *Prosimiæ.*

Superior true molars quadrituberculate; hallux not opposable; V. *Insectivora.*

Superior true molars trituberculate or bituberculate;[1] hallux not opposable: VI. *Creodonta.*

While the above scheme defines the groups exactly, and, so far as can now be ascertained, naturally, I do not doubt but that future research among the extinct forms will add much necessary information which we do not now possess. It is possible that the group I called Mesodonta may yet be distinguished from the Insectivora by characters yet unknown. But I cannot admit any affinity between this group and any form of "Pachyderms," as suggested by Filhol, or of Suillines, as believed by Lyddeker.[2] Such suppositions are in direct opposition to what we know of the phylogeny of the Mammalia. These views are apparently suggested by the Bunodont type of teeth found in various Mesodonta, but that character gives little ground for systematic determination among Eocene Mammalia, and has deceived palæontologists from the days of Cuvier to the present time. The only connecting point where there may be doubt as to the ungulate or unguiculate type of a mammal is the family *Periptychidæ*, of the suborder *Condylarthra.* The suborder *Hyracoidea* may furnish another index of convergence.

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[1] The internal tubercle is wanting in the last two superior molars in *Hyænodon.* This genus, of which the osteology remains largely unknown, has been stated by Gervais to possess a brain of higher type than the Creodonta. Prof. Scott, of Princeton, is, however, of the opinion that this determination is erroneous, and that *Hyænodon* is a true Creodont in this and other respects. If so, the genus will perhaps enter the *Amblyctonidæ.*

[2] Memoirs Geological Survey India, Ser. x, 1883, p. 145.

The families included in these suborders will be the following:

TÆNIODONTA. *Calamodontidæ; Ectoganidæ.*

TILLODONTA. *Tillotheriidæ.*

DAUBENTONIOIDEA. *Chiromyidæ.*

PROSIMIÆ. *Tarsiidæ;* (?) *Anaptomorphidæ;* (?) *Mixodectidæ; Lemuridæ.*

INSECTIVORA. *Soricidæ; Erinaceidæ; Macroscelidæ; Tupæidæ; Adapidæ;*[1] *Arctocyonidæ.*

CREODONTA. *Talpidæ; Chrysochlorididæ; Esthonychidæ; Centetidæ* (= *Leptictidæ* olim); *Oxyænidæ; Miacidæ; Amblyctonidæ; Mesonychidæ.*

I at one time called this order by the name Insectivora, a course which some zoologists may prefer. But a name should as nearly as possible adhere to a group to which it was first applied, and whose definition has become currently associated with it. Such an application is correct in fact, and is a material aid to the memory. There are various precedents for the adoption of a new general term for a group composed of subordinate divisions which have themselves already received names.

In order to determine the number of internal tubercles in some of the *Insectivora*, so as to ascertain the affinities of some questionable genera, it is first necessary to examine the homologies of the cusps of the molar teeth. The opossums are characterized by the presence of three longitudinal series of tubercles on the superior molar. The homologies of these cusps are rendered clear by the character presented by the fourth superior premolar, where the anterior intermediate is wanting. The external cusps are really such, and are not developed from a cingulum external to the true external cusps, as appears at first sight to be the case with such animals as the *Talpidæ*. The intermediate cusps are really such, although the posterior looks like the apex of a V-shaped external cusp. In *Peratherium* the external cusps are smaller than in *Didelphys*, and the intermediate V's so much

[1] Two species of *Pelycodus* must be removed from this genus and family, and be placed in the Creodonta with *Mioclænus*. They are the *P. pelvidens* and *P. angulatus*, which have the posterior inner tubercle of the superior molars, a mere projection of the cingulum. I place them in a new genus which differs from *Mioclænus* in the possession of an internal cusp of the fourth inferior premolar, under the name of *Chriacus;* type *C. pelvidens.*

better developed, that the type is much like that of the *Talpidæ*, in whose neighborhood I originally referred it.

This leads to a consideration of the question of the homologies of the cusps in the genera of the old order of *Insectivora* proper, and of the *Creodonta*. Mr. St. George Mivart has briefly discussed the question, so far as relates to the former group.[1] He commences with the primitive quadritubereulate type presented by *Gymnura* and *Erinaceus*, and believes that the external cusps occupy a successively more and more internal position till they come to be represented by the apices of well developed V's, as in the ungulate types. The V's are well developed in several families, and in *Chrysochloris* the two V's are supposed to be united and to constitute almost the entire apex of the crown, while in *Centetes* the same kind of a V forms a still larger part of the crown.

I believe that these conclusions must be modified, in the light of the characters of various extinct genera, and of the genus *Didelphys*. In the first place there is an inherent improbability in the supposition that the external V's of the superior molars of the *Insectivora* have had the same origin as those of the *Ungulata*. The movements of the jaws in the two groups are different, the one being vertical, the other partially lateral. In the one, acute apices are demanded; in the other, grinding faces and edges. We have corresponding V's in the inferior dental series, and we regard those as produced by the connection of alternating cusps by oblique ridges. In homologizing the superior cusps, we have as elements, two external, two intermediate, and two internal cusps. The first are opposite the external roots, and the anterior internal is opposite the internal root.

First, as regards *Centetes* and *Chrysochloris*. Besides the strained character of the hypothesis that supposes the V-shaped summit of the crown to represent two V's fused together, there is good evidence obtainable in support of the belief that the triangle in question is the usual one presented by the *Creodonta*.

This clearly consists of the two external and the anterior internal cusps united by angular ridges. The form is quite the same as in *Leptictis* and *Ictops*, and nearly that of *Deltatherium*, where the external cusps are present. *Centetes* and *Chrysochloris* only differ from these in that the external cusps are wanting. In

[1] Journal of Anatomy and Physiology, ii, 188, figures.

addition, the latter genus presents a rudiment of the posterior inner tubercle, as is seen in *Deltatherium*. An explanation similar to this is admitted by Mr. Mivart to apply to the cusps of the inferior molar of *Centetes*. It remains to ascertain whether the cusp in this genus, *Chrysochloris*, etc., represents an intermediate or not.

Secondly, as regards the *Talpidæ* and *Soricidæ*, where the external V's are well marked. If we examine the external cusps in the genus *Didelphys*, we find that the posterior one becomes gradually more anterior in its position, until on the second true molar it stands largely above the interspace between the roots, instead of over the posterior root. It will also be seen that the anterior intermediate tubercle is distinct, and of insignificant proportions, while the posterior intermediate is large and is related to the posterior external, as is the apex of a V to its anterior base. In this arrangement I conceive that we have an explanation of the V's of the *Talpidæ* and *Soricidæ*. The first true molar of *Scalops* is a good deal like that of *Didelphys*, but the anterior cusp is larger and there is no anterior intermediate cusp, while the posterior external is of reduced size. The posterior V is better developed than in *Didelphys*, but is composed in the same way, of a posterior intermediate cusp, and a posterior external with a posterior heel. These are united by stronger ridges in *Scalops*, *Condylura* and *Blarina*, than in *Didelphys*. On the second true molar in *Scalops*, a V represents the anterior external cusp of the first true molar. Whether this V has a constitution like the posterior one, *i. e.*, is composed of external and intermediate cusps joined, is difficult to determine; but it is probably so constituted. It seems to be pretty clearly the case in *Blarina*, where the fourth premolar and first true molar may be compared, with a resulting demonstration of the correctness of this view. In *Condylura*, the V's have become more developed and the external cusps reduced, so that the analysis is more difficult.

This interpretation applied to *Urotrichus* and *Galeopithecus* gives them quadrituberculate molars, not trituberculate, as determined by Mivart. *Mystomys* is tritubercular. The intermediate tubercles are present, but are imperfectly connected with the external, so that V's are not developed (*vide* figures of Mivart and Allman). This genus offers as much confirmation of the homology

here proposed as do the opossums, but it differs from the latter in having the anterior intermediate tubercle the larger, instead of the posterior. *Mystomys* and *Solenodon* also confirm my determination of the homologies in *Centetes.*[1]

In conclusion I give the following synoptic view of the constitution of the superior molar teeth in various genera of the *Bunotheria.*

CUSPS PRESENT.

External. Intermediate. Two internal.	External. No intermediate. Two internal.	External. Intermediate One internal.	External. No intermediate. One internal.	No external. No intermediate. Two internal.	No external. No intermediate. One internal.
Adapidæ.	Gymnura.	Mystomyidæ	Mesonyx.	Chrysochloris (2d internal rudimentary)	Centetes.
Tupæidæ.	Erinaceus.	Mioclænus.	Leptictis.		
Galeopithecidæ	Macroscelididæ	Miacis.	Stypolophus.		
Soricidæ.		Talpidæ.	Oxyæna.	Solenodon. (do.)	
Urotrichus.		(Didelphys.)	Chriacus.		
		(Canis.)	Deltatherium		
			Esthonyx. (2nd internal rudimentary)		

[1] This view was first advanced by the writer in the Annual Report U. S. Geol. Survey Terrs., 1873 (74), p. 472.

APRIL 10.

Rev. H. C. McCook, D. D., Vice-President, in the chair.

Thirty-two persons present.

Notes on Echinocactus.—Mr. Thomas Meehan announced, at the meeting of the Botanical Section, the discovery of sensitive stamens in *Echinocactus Whipplei.* This peculiarity had been long known in *Opuntia Rafinesqui* and allied species, as well as in *Portulaca*, which, though its natural order was regarded as very distinct in systems of classification, had much in common with *Cactaceæ.* The motion of the stamens when touched in this species of *Echinocactus* was not instantaneous, several seconds sometimes elapsing before the motion responded to the touch. The flowers of this species are unable to expand to any great extent, on account of their short tube, surrounded by long and stiff spines. If the flowers could expand as in *Opuntia*, and the stamens lie flat, as in that genus, Mr. Meehan suggested that the motion might be equal to that observed in *Opuntia.* The motion in *Opuntia* was not always up towards the pistil, but might be horizontal, to the right or to the left—there seemed to be no rule. That seemed to be the case also in the *Echinocactus.* The bending was from the base, as the filament retained a perfectly straight line during the movement.

Mr. Meehan further remarked that in descriptions of cactaceous plants, the relative length of the pistil to petals or stamens was often given. He had observed that in many species, about the period of the ejection of the pollen from the anther-cells, the stamens and style were of about equal length, the stellate stigma being just above the mass of anthers; but the style continued to grow after the maturity of the anthers, and, in *Echinocactus Whipplei*, would finally reach to near half an inch above. He had not been able to get any genera of *Cactaceæ* to fruit under culture except *Opuntia*, unless they were artificially pollinized. By the application of the flower's own pollen to the stigma, they sometimes perfected fruit.

Mr. Meehan also remarked that in botanical descriptions, *Echinocactus Whipplei* and *Echinocactus polyancistrus* were described as having greenish or yellow flowers. His plants had bright purple flowers, and he had no doubt were correc ly referred to the species named. They were from southern Utah.

Referring to *Echinocactus uncinatus*, he remarked that specimens collected in New Mexico by George Vasey, and blooming under culture, had the central spine double the length of the others, whereas in the figure in Pfeiffer they are all represented as uniform, and there were no green-edged sepals or bracts at the

base of the flower, as in that figure, warranting the var. *Wrightii* Eng.

On the Relations of Heat to the Sexes of Flowers.—At the meeting of the Botanical Section on April 9, Mr. THOMAS MEEHAN referred to his past communications to the Academy, showing that in monœcious plants female flowers would remain at rest under a temperature which was sufficient to excite the male flowers to active development. Hence a few comparatively warm days in winter or early spring would bring the male flowers to maturity, while the female flowers remained to advance only under a higher and more constant temperature. In this manner the explanation was offered why such trees were often barren. The male flowers disappeared before the females opened, and hence the latter were unfertilized. He referred especially to some branches of *Corylus Avellana*, the English hazel-nut, which he exhibited before the Section last spring, in which the male flowers (catkins) were past maturity, the anthers having opened and discharged their pollen, and the catkins crumbling under a light touch, but there were no appearances of action in the female flower-buds. There were no nuts on this tree last season. The present season was one of unusually low temperature. There had not been spasmodic warmth enough to bring forward the particularly excitable maple-tree blossoms. The hazel-nut had not, therefore, had its male blossoms brought prematurely forward. He exhibited specimens from the same tree as last season, showing the catkins in a young condition of development, only half the flowers showing their anthers, while the female flower-buds had their pretty purple stigmas protruding from nearly all of them.

Mr. Meehan remarked that his observations the past few seasons had been so carefully made that he hardly regarded confirmation necessary, but believed the further exhibition of these specimens might at least serve to draw renewed attention to his former communications.

APRIL 17.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

Twenty-two persons present.

The following was ordered to be printed:—

AZTEC MUSIC.

BY H. T. CRESSON.

Primitive music seems to have been limited to a few sounds, produced either by percussion or by means of rude instruments; these sounds or notes in most cases, as musical authorities unite in asserting, represented five tones of the diatonic scale, viz., the tonic or prime note, second, third, fifth and sixth. This would indicate that most barbarous nations were ignorant of the fourth and seventh tones of the scales as known to us. Among the Aztecs, whose remains show superior advancement in the arts, a more thorough appreciation of music evidently existed. To speak first of their percussive music, the huehuetl or large drum of the great temple, at the ancient pueblo of Tenochtitlan, was covered by the skins of serpents, and when beaten could be heard at a distance of several miles. They had clay balls or rattles placed inside of their grotesque clay images, also within the handles attached to their earthenware vessels, which are generally hollow, and contain pebbles or small pellets of clay.

The Poinsett collection possesses several objects among its interesting and valuable specimens of ancient Mexican art, which, unfortunately, are much injured or almost destroyed; these are in the form of a serpent's head, with protruding forked tongue, and have a ball of clay placed within the mouth. The first-named portion is attached to a handle of terra-cotta, to which, after an examination of several specimens, I am inclined to think, were joined large hollow cylinders of the same material. A portion of these still remain united to the handle, suggesting that they must have been concave. When shaken to and fro, the ball within the head of this terra-cotta serpent rebounds from side to side, thus producing a clear sound resembling that given by our American rattlesnake (*Crotalus horridus*) when irritated. A series of these instruments may have been used in their religious ceremonies, and were no doubt placed upon cylinders of large size, balanced so as to regain the perpendicular when set in motion, and in swaying from side to side produced a rattling sound, suggesting that of the serpent above named, which was esteemed a sacred animal by these people.

The desire to make imitations of objects by which they were surrounded emit musical tones, was no doubt suggested by the songs of birds and various sounds produced by animals. Gurney, in his admirable work entitled the "Power of Sound," page 143, states that the third note of the scale has had a natural charm for man as for the cuckoo; thus this well-known musical authority recognizes the fact that certain musical sounds or tones were agreeable to the ears of man; and hereafter, in a series of whistles or pitch-pipes, exhumed from the sepulchres of these Aztec people, I will endeavor to show that one of them is pitched almost precisely in the tones given by the Mexican *Hyladæ.* That musical sounds attract the attention of barbarians and savages, is well authenticated by travelers and those who have lived among them; it may therefore be supposed that these children of nature noticed and strove to reproduce sounds, which, however harsh and unmusical to us, to them were pleasing, because they recalled familiar objects. I am of the opinion that the chattering of macaws and parrots can be imitated upon several instruments I have denominated bird-calls, belonging to the Poinsett collection, in the Academy of Natural Sciences of Philadelphia; by short, quick blowing, they emit sounds very similar to those given by a flock of the above-mentioned birds.

Wind instruments were known to the Aztecs, as above indicated, by the bird-calls; they also possessed flutes, whistles made of sea-shells and flageolets of baked clay or terra-cotta.

There is a vase of this last-named material in the W. S. Vaux collection, now in the museum of the Academy of Natural Sciences of Philadelphia, upon which musical sounds may be produced, by applying the lips to certain parts. This unique specimen of a wind instrument was formerly in the possession of my friend Professor Leidy, and afterward came into that of the late W. S. Vaux, Esq. It is somewhat Roman in form, of a dark color, and ornamented by four grotesque masks, placed around the exterior edge or upper rim of the base, between which, and the interior of the vessel, there is a broad plane some two inches in width, that is perforated at intervals by small slits at each side, exactly opposite the masks. When covered by the lips and blown into, these slits emit certain musical sounds; by closing one of the eyes in the masks, which are hollow and connect by means of air-passages with the interior of the vase and slits upon the plane surface, some approach to a

half-tone lower than that produced by leaving open the holes, can be obtained. The discovery of the musical powers of this vase is interesting, and I shall repeat the account of it given to me by Professor Leidy: "Having been attracted by its artistic form and decoration, I bought the vase, and some time afterward proceeded to clean the slits or elongated holes in the rim and eyes of the masks, these being filled with earth; in applying my lips to the slits, so as to blow out particles of dirt which remained therein, I found to my surprise that they emitted musical sounds."

Mr. E. A. Barber, in a valuable article upon "Indian Music," contributed to the *American Naturalist* of March, 1883, page 270, mentions a curious wind instrument of turtle-like form, which was procured on the island of Ometepec, by the late Dr. Berendt (during his recent excavations among the ruins and mounds of Central America), which, by certain manipulations, can be made to produce a number of airs. . . . . . "This unique relic is the first of the kind found among the remains of the old Nahuatl races which evinces any particular advancement in the art of music."

I must beg leave to differ from Mr. Barber in this last assertion, from the fact that in the Poinsett collection there exist Aztec flageolets capable of producing not only the fourth and seventh of the diatonic scale, but also the entire chromatic scale. A description of one of these flageolets will first be necessary, before explaining how the above-mentioned scales may be obtained. It measures nine inches in length, and the thickest portion is about three-quarters of an inch in width—being generally in the centre of the flageolet. The neck is considerably flattened, and measures seven-eighths of an inch in width, gradually contracting at the mouth-hole, and growing more cylindrical in form as it approaches the centre of the instrument. Viewed in profile a graceful curve from above downward joins the neck to the body. At the junction of these two parts may be seen protruding the portion which I have denominated the clay reed (Plate III, A); through this the current of air passes from the lungs of the performer into the body of the instrument, which is pierced by four finger-holes.[1] The

[1] After a careful search I am unable to find in the Poinsett collection of Mexican antiquities, any Aztec flageolets possessing five finger-holes, as stated by Mr. Barber in the *American Naturalist* of March,

terminal portion, or bell, is slightly concave exteriorly, of circular form, and decorated with designs of unique patterns, which have been stamped thereon while in a moist condition, by means of forms or dies; some of these, evidently used for a similar purpose, and made of baked clay, are to be seen in the Academy. The internal portion of this bell is hollow, becoming convex as it approaches the edges, and contracting at the point of connection with the tube or barrel, to a thickness of half an inch. Around this is formed a small cup-like cavity, which bears a most important part in performing upon the instrument. A careful examination and analysis of the construction of these instruments was made from a large number of fragments, some of which were splintered and broken in such a manner that the internal structure was clearly shown. It appeared that they must have been formed in four parts, the neck, clay-reed, body and foot or bell, which were afterwards united together while in a moist condition. Traces of the sutures, although in most cases concealed by the modeling, can be detected in many of the instruments.

It has been asserted in the beginning of this article, that the fourth and seventh tones of the diatonic scales could be produced upon these four-holed instruments (Plate III, fig. 1), and as this assertion is somewhat contradictory to most authorities who have hitherto written upon the subject, my method of proceeding shall be given in detail, with the result obtained. I propose to show—

I. That the fourth, seventh and octave tones of the diatonic scale as known to us exist in the Aztec instruments.

II. That the additional sounds or semi-tones, which constitute the chromatic scale, are likewise present.

That the *fourth* and *seventh* tones do exist in the scale of the ancient Mexicans or Aztecs, and can be produced upon their clay flageolets, will be hereinafter shown.

The objection may be raised, however, that although we, with our knowledge of music, which has only been gained by the experience and wisdom of centuries, can obtain all these tones, yet the Aztecs may have been ignorant of the ability of the

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1883, page 270; although the ancient Peruvians seem to have possessed flutes of this description, one of which is now in the cabinet of the American Philosophical Society of Philadelphia, and is mentioned by Mr. H. S. Phillips, Jr., their Corresponding Secretary, in his interesting report for 1882, p. 15.

instruments under consideration to produce them. In answer to this, I will simply state that such an objection would be against the evidence of historical and musical authorities, who have demonstrated that musical instruments of all nations, even of the most savage, have been constructed with a thorough knowledge of their full value and ability in the production of musical tones. This is shown, even in our day, by the savage-tribes of Africa, and those of almost inaccessible regions in Asia, who thoroughly understand the instruments in use among them; and from these, we, with all our knowledge and musical comprehension, produce no other tones than can the natives themselves.

The flageolets, having been tested and compared with the flute and organ, were found to be pitched in the following keys: two of similar color and shape stand in the key of C natural, and one of like color in B natural; another, smaller in size, stands in F sharp, and the most perfect sounds emitted came from the flageolet of a dark brown color, which was pitched in the key of B flat; upon this instrument most of the experiments were conducted. It was found that by covering all four holes of the flageolet with the finger, C natural was produced with the bell open (Plate II), and by closing this last-named portion with the little finger, B flat could be obtained, thus lowering the instrument a tone and a half in sound. This action I have denominated finger-stopping, and it is a curious fact, that this same method has been practiced by musicians of our day with the hand upon the French horn. The fact having been demonstrated, that the cavity in the cup-shaped depression had been used for this purpose, it was necessary to find whether the finger-stopping could best be accomplished by the fourth finger of the right hand, or the little finger thereof. After repeated trials, the little finger was found best adapted to that purpose, which obliges the musician to hold the flageolet in the following manner: the body of the instrument rests between the ball of the thumb and the first or index finger of the left hand, covering 4 D (Plate II), thus supporting the instrument. Hole No. 3 C is covered by the second finger of the same hand, No. 2 B by the index finger of the right hand, and 1 A by the second finger; the little finger is used as stated—for the finger-stopping. The instrument being held as above described, the *fourth* of the scale or E flat can be obtained by half-closing the second hole or letter 2 B (Plate II), 3 C and 4 D remaining closed. The *seventh*, which

is A natural, is obtained by closing 2 B, and leaving the other holes open. If these notes thus obtained be compared by a competent musician with any wind instrument of concert pitch, such as the flute, the truth of this assertion will be evident.

Musical authorities seem to have arrived at the somewhat hasty conclusion, that the Aztec people were only possessed of a knowledge of the so-called Pentatonic scale, but with all due deference to their opinion, I must beg leave to differ upon this point, as it is not probable that intervals which are so easily obtained, were unknown to artisans capable of manufacturing these flageolets of terra-cotta, pitched in different keys, and of determining the exact distance apart of the finger-holes. This superior knowledge of their artisans is still further shown by the ingenious and scientific arrangement of the finger-perforations made in their whistles, or pitch-pipes, described hereafter, which, when covered, reduce the tone exactly a fourth; equaling the dominant of the scale.

The more I study the musical instruments of these people, the firmer becomes my conviction that they must have possessed a full knowledge of the diatonic and chromatic scales; which can be produced upon the four-holed clay flageolets by any one capable of manipulating our modern flutes.

The instrument which stands in B flat, can be made to produce that note by closing all the holes and the bell (full finger-stop). B natural is more difficult to obtain, and is produced by a slight movement, with much care and precision, of the little finger outward from the centre of the cup-like cavity; from which fact, and the skill required to produce C sharp, E flat and G natural, I am inclined to believe that the Aztecs, like the ancient Peruvians, possessed musicians trained from early youth, who no doubt assisted in their religious ceremonies and festivals. C natural is produced with the four holes closed, and the cup-like cavity open.[1] C sharp, 1 A half open, 2 B, 3 C, 4 D closed; D natural, 1 A entirely open, 2 B, 3 C and 4 D closed. E flat, or the *fourth* of the scale, is produced by leaving 1 A open, 2 B half-closed, 3 C and 4 D closed; E natural, 2 B open, 1 A, 3 C and 4 D closed; F natural, 1 A and 2 B open, 3 C and 4 D closed;

[1] It may be seen in the Plate, that where it is necessary to close the cup-like cavity in these flageolets, S is used to indicate entirely closed, half S for half-closed, or half finger-stop, and O for open bell.

F sharp, 1 A open, 2 B closed (see Plate), 3 C open and 4 D closed; G natural, 1 A open, 2 B half-closed, 3 C open, and 4 D closed; A flat or G sharp, 1 A, 2 B, 3 C open, and 4 D closed. A natural, the *seventh* of the scale, 1 A open, 2 B closed, 3 C and 4 D open. B flat, *octave*, is obtained by leaving all the holes and the bell open.[1] It becomes apparent by the above scales obtained upon these four-fingered clay flageolets, representing the keys of B flat, B natural, C natural and F sharp, that many interesting combinations could be obtained by their simultaneous use, such as concerted pieces, each flageolet sustaining a part.

Professor J. S. Cox says: "I cannot imagine what object they had in view for pitching their flageolets in different tones, unless each instrument was intended to perform a separate part, which when played together produced harmonious sounds; this method is used in our day by some of the fife and drum corps, there being three different kinds of fifes used in concert. . . . . . . They are too truthful in their various pitches (such as B natural, C natural, B flat, F sharp) for these to be accidental." These opinions of Professor Cox, whose reputation as a soloist upon the Boehm-flute is well known in America, cannot fail to impress the cautious observer that something more than mere accident is represented by these instruments standing in different keys.

The Aztec whistles, or pitch-pipes, in the collection of antiquities already mentioned, were ascertained to stand in the key of E flat, and together yield a full octave, so that four persons could play simple melodies upon them.[2] The fact that duplicates exist in several of the above-mentioned whistles and flageolets adds much probability to the theory already advanced, that these are not tones which happen to stand in the keys enumerated, but that

[1] It has been suggested that it was possible to produce the entire scale (without closing the bell) by means of careful finger-manipulation upon any reed-formed instrument with four holes. Six notes can be obtained by careful fingering; an approach to the seventh (though very imperfect and flat in sound) can be produced by leaving all the holes open, and blowing strongly. After repeated trials, I am of the opinion that there is no way of producing the octave upon these four-holed Aztec instruments, except by means of finger-stopping.

[2] I have numbered these pipes from one to eight (tonic to octave). They, with their existing duplicates, may be seen in the museum of the Academy of Natural Sciences of Philadelphia.

they were made by artisans who thoroughly understood the principles of the scales as known to us; moreover, upon these whistles a ninth, eleventh and twelfth can be obtained (the tenth or G natural is missing), which gives, with this exception, an octave and a fourth.

Certain grotesque decorations upon these instruments may have some signification; the one which produces E flat, or the tonic of the scale, possessing no ornamentation, is an exception to most all the others, which are enveloped by frog-like appendages or legs, with feet attached. The bodies are tipped with an ornament resembling the tails of young sparrows, and the underneath portion thereof is furnished with an appendage or button, pierced by a hole, through which a cord was passed by which it was probably attached to the body of the performer. (Plate III, fig. 3.)

The ingenious way in which the Aztec whistles are modeled is well worthy of description, and must have occupied a great deal of time to accomplish it. They have no doubt been made in four parts, like the flageolets, and also possess a clay reed, which is enveloped by the neck, to which is attached the body, furnished with a vent-hole. This body is a circular form, something like the bulb of a retort (such as used in our laboratories), and was no doubt fashioned upon a ball-shaped or circular form, and then cut into two portions; one of these was joined to the neck, and the other piece fastened to it by careful modeling. An example of this can be seen in the double whistle (Plate III, fig. 4), where these two parts are shown somewhat separated; no doubt the effect of the action of the heat while in the kiln. The object of thus forming the body in two portions can readily be seen by an examination of these instruments, which are, with few exceptions, very carefully made, and the interior portion of the body quite smooth and regular within, as any imperfection would interfere with the regularity and fulness of the sound. A smooth round form of some material was chosen upon which to model or shape the body portion, which it would be necessary to divide in two, so as to release it therefrom, thus explaining the division of the above-named parts. The bodies of these whistles are each pierced by a stop-hole, which, if left unclosed when the instrument is blown, gives a clear piercing sound; by covering the same, a note one-fourth below that given while open, is produced. This hole is generally placed to the

right side of a line drawn around the body from the centre of the vent. In playing the scale of E flat, all of the holes in these pipes are left open with the exception of that of pitch-pipe No. 2, which is closed, so as to produce F natural.

To recapitulate, it would appear: I. That upon the four-holed clay flageolets the chromatic and diatonic scales can be produced with a full octave. II. That the clay whistles or pitch-pipes, which may be manipulated in quartette, will produce an octave and a fourth. III. From the facts above shown, the Aztecs must have possessed a knowledge of the scales as known to us, which has been fully tested by comparison with the flute and organ.

These superior attainments in the science of music suggest that musicians of our day have arrived at a somewhat hasty decision in regard to the music of these ancient people having been confined within the narrow limits of a so-called pentatonic scale, as it is highly probable that they may have had melodies containing all the tones of the chromatic scale. Their ingenuity and skill in the production of these instruments may well claim the admiration of modern musicians and artisans. It is earnestly hoped that a much-neglected branch of American ethnology—the study of native American music—will hereafter receive the proper investigation due so important a subject. No doubt the researches now in progress, under the auspices of the Bureau of Ethnology at Washington, will develop many interesting facts in this connection.

APRIL 24.

The President, Dr. LEIDY, in the chair.

Thirty-nine members present.

The following papers were presented for publication:

"On the Structure of the Skull of the Hadrosauridæ," by Edward D. Cope.

"On some Vertebrate Forms from the Permian of Illinois," by Edward D. Cope.

A Social Heliozoan.—Prof. LEIDY exhibited drawings and made some remarks on a singular Heliozoan recently observed by him. His attention had been directed to it by Mr. Edward Potts, who discovered it, contained in considerable numbers in water, with vegetal debris, from Lake Hopatcong, N. J., where it had been obtained last autumn. The animal occurred mostly in groups composed of numerous individuals. One of these groups, of irregular, cylindroid shape, 0·84 mm. long by 0·36 mm. broad, was estimated to contain upwards of a hundred individuals. They reminded one of a mass of tangled burs. They remained nearly stationary even for twenty-four hours, and exhibited so little activity, that without careful scrutiny they might readily be taken for some inanimate structure. The individuals composing the groups appeared to be connected together only by mutual attachment of their innumerable rays, and none were observed to be associated by cords of protoplasm extending between the bodies of the animals, as seen in *Raphidiophrys elegans*. The individuals associated together were of two kinds: those which were active, and a smaller proportion which were in an encysted, quiescent condition.

The active individuals resembled the common sun-animalcule. The body was usually spherical or oval, but variable from contraction, colorless, granular and vesicular, with a large central nucleus more or less obscurely visible and variably granular, with three or four or more peripheral contractile vesicles. The body had a thick envelope of delicate protoplasm, with innumerable and immeasurably fine, straight spicules. The envelope with the spicules extended in numerous conical rays, from which proceeded numerous immeasurably fine granular rays. The encysted individuals presented the same essential constitution, except that the body was regularly spherical, enclosed by a structureless envelope or membrane, contained no contractile vesicles, and the enveloping protoplasm was devoid of granular rays. The body of the active individuals measured from 0·024 to 0·036 mm. in diameter; in the encysted individuals, usually about 0·02 mm. An active individual, with the body 0·033 mm. in diameter, with its envelope was 0·055 mm. in diameter. An encysted individual, with the body 0·02, with its envelope was 0·036 mm.

The active individuals were observed to feed on two species of

minute monads, which were swallowed in the same manner as in *Actinophrys*. After some hours, a few individuals appear to have separated from the surface of one of the groups, but they were as stationary and sluggish as when in association with others.

The species is apparently distinct from others which have been previously noticed, and may be named *Raphidiophrys socialis*.

Daniel E. Hughes, M. D., and Edwin S. Balch were elected members.

MAY 1.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

MAY 8.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

Canadian Notes.—Mr. JOS. WILLCOX remarked that a noticeable feature in the Canadian landscape is the scarcity of springs of water and running streams. The latter, when they exist, are almost exclusively the outlets of lakes, which are very numerous in that country. The abundance of lakes there is a fortunate occurrence, as they store a large amount of water for use in supplying power to mills and drink for live stock during the dry summer and early autumn. By the action of the ancient glaciers a large portion of the soil of Canada has been carried away, the underlying rocks being usually near the surface, and in many cases visible above the ground. It is reasonable to conclude that the absence of springs of water is due to the prevailing scarcity of deep soil, the material necessary to soak up a large amount of rain and melting snow, from which springs are supplied, being deficient. His observations were confined to the country which lies north of Kingston and Brockville, in the Province of Ontario. In Jefferson and St. Lawrence Counties, in New York, small isolated areas of Potsdam sandstone occur, overlying the Laurentian granite and limestone. Sometimes they cover a space of only a few square yards. North of the St. Lawrence River, for a distance of more than one hundred miles, the Laurentian rocks are frequently covered with disconnected patches of calciferous sandstone and Trenton limestone. These remnants undoubtedly indicate the former existence of those rocks of great extent, overlying the Laurentian granite and limestone, the former having been subsequently removed by erosion. The ancient glaciers have probably performed a large share of this work, as their erosive action, which has torn and worn away the granite rocks to a considerable extent, would operate more rapidly on the softer limestones and sandstones.

The following were ordered to be printed:—

ON THE CHARACTERS OF THE SKULL IN THE HADROSAURIDÆ.

BY E. D. COPE.

In the year 1841, Professor Owen[1] distinguished the *Dinosauria* from other reptiles, as an order characterized by the structure of the sacrum, the limbs, and the articulations of the ribs with the vertebræ. The definition of the order remained without accession, until, in 1870, Prof. Huxley[2] determined the characters of the pelvis. This important addition to our knowledge placed the order on a firmer basis. No definitions were yet derived by either author from the skull, so that the relationships of the *Dinosauria* still remained obscure. In 1861 Professor Owen described part of the skull of a species of *Scelidosaurus* from the English Lias. On this imperfect basis I ventured in 1870[3] to determine whether the *Dinosauria* are monimostylicate or streptostylicate; and I added to the definition of the order, "attached quadrate;" and later[4] "os-quadratum articulated with its suspensorium by suture," thus placing these reptiles in the monimostylicate series. This character, if found to be general in the order, would distinguish it well from the *Lacertilia*, and give a point of affinity to the *Crocodilia*.

This order embraces a number of families. I at one time proposed to refer them to three suborders,[5] and Huxley concluded that they should be arranged in two suborders.[6] Professor Marsh, after showing that one of my three orders (*Symphypoda*) was established on characters erroneously ascribed to its type by previous writers, proposed to divide the *Dinosauria* into seven suborders. He later[7] regarded the *Dinosauria* as a subclass, and divided it into five orders, the fourth of which is composed of three suborders. The characters used by Marsh to define this supposed subclass, do not differ from those previously developed as above cited, excepting that a number are introduced which

[1] British Fossil Reptiles.

[2] Quarterly Journal of the Geological Society, p. 33.

[3] American Naturalist, 1871, p. 508.

[4] Proceedings Amer. Assoc. Adv. Science, 1870 (1871), p. 233.

[5] Transactions American Philosophical Society, xiv, 1869, 90-99.

[6] Quarterly Jour. Geolog. Soc., London, 1870.

[7] Amer. Jour. Sci. Arts, 1882, p. 83.

cannot be used to distinguish a subclass, or in some instances an order. In like manner, the definitions of his orders and suborders embrace many characters which are not usually regarded as defining groups higher than families. Such, *e. g.*, are the numbers of toes; relative sizes of fore- and hind-limbs; solidity or non-solidity of bones; presence or absence of dermal armor. Much light was, however, thrown on the subject by Professor Marsh, by the numerous characters he brought to light, and the number of forms he defined.

The constitution of the pelvis is shown by Marsh to differ materially in the different members of the *Dinosauria*. As this region presents characters diagnostic of the order *Dinosauria* itself, its modifications within the order become of importance. The ungulate or unguiculate character of the feet must also not be neglected, although of less importance than in the mammalia. If the order is susceptible of division into suborders, it must be by means of the following definitions, which I select from Marsh's diagnoses:

Feet ungulate; pubes projecting and connected in front; no postpubes; *Opisthocœla.*

Feet ungulate; pubes projecting free in front; postpubes present; *Orthopoda.*

Feet unguiculate; pubes projecting downwards and coössified distally; calcaneum not produced; *Goniopoda.*

Feet unguiculate; calcaneum much produced backwards; ? pelvis; *Hallopoda.*

I have used for these orders the oldest names when the definitions first given were not erroneous, although they were inadequate. Thus I think the name *Opisthocœla* (Owen[1]) must take precedence of *Sauropoda* Marsh. I combine Marsh's two divisions, *Stegosauria* and *Ornithopoda*, into one, and use the name I gave in 1866 and redefined in 1869,[2] for the division thus remodeled. The name *Goniopoda*, given at the same time, I designed to embrace the carnivorous *Dinosauria*, but included in my definition some characters which are of less significance than I then attached to them.

Prof. Huxley recognized three families: the *Scelidosauridæ* and

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[1] Palæontology, 1860, p. 272.

[2] Transactions American Philos. Soc., xiv, p. 90. See American Naturalist, 1882, March.

Iguanodontidæ, which belong to the *Orthopoda*, and the *Megalosauridæ*, which pertains to the *Goniopoda*. To the former, I added the family *Hadrosauridæ* in 1869, and in 1877 I defined the *Camarasauridæ*, of the suborder *Opisthocœla*.[1] To this family Marsh gave, in 1882, the name of *Atlantosauridæ*.[2] At the same time he proposed a number of families, some of which will be retained, while others are not sufficiently defined.

The *Hadrosauridæ* are, so far as known, confined to the upper cretaceous beds of North America, and continued, with their accompanying carnivorous genera, later in geological time than any other *Dinosauria*. Besides the genus *Hadrosaurus*, I have added the genera *Diclonius* and *Cionodon*, and it is possible that the genera *Monoclonius*, *Dysganus* and *Agathaumas* also belong to it. These types are all found in the Laramie formation, excepting *Hadrosaurus*, which is as yet only known from the older Fox Hills or Mæstrichtian, and Pierre epochs. From the latter formations, came also *Hypsibema*, possibly a member of the same family.

As the latest in time, the *Dinosauria* of the Laramie possess an especial interest. Having recently obtained a specimen of a species of the genus *Diclonius* Cope, I am in a position to give not only the characters of the family and suborder more definitely than heretofore, but also to furnish some cranial characters of the order, which have been hitherto little known or unknown. The species on which these observations are made is the *Diclonius mirabilis*,[3] of Leidy. It is represented by a nearly complete skeleton, including the skull, which was discovered by Messrs. Wortman and Hill in the Laramie beds of Dakota. At present, I only describe the general characters, and those chiefly cranial, leaving the complete description and iconography for my forthcoming volume on the Laramie vertebrate fauna.

The character which distinguishes this genus from *Hadrosaurus* is the attenuation of the astragalocalcaneum, and its coössification with the tibia. *Ornithotarsus* differs from *Diclonius* in the pro-

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[1] Proceedings American Philosophical Soc., 1877, p. 243.

[2] Amer. Jour. Sci. Arts, 1882, p. 83.

[3] This species is part of the one called by Leidy *Trachodon mirabilis*, who included in it a species of *Dysganus*. He did not characterize the genus *Trachodon*, and afterwards abandoned it. (Proceedings Academy, Phila., 1868, p. 199.)

duced calcaneum, which supports the extremity of the fibula. There are four digits of the anterior foot, and three of the posterior. The fore-limb is much shorter than the hind-limb, so that the attitude of the animal was kangaroo-like, as in *Hadrosaurus* and *Lælaps*. In this it differed from *Monoclonius*,[1] where the anterior limbs are as long as the posterior.

Ordinal Characters.—The quadrate bone is immovably articulated to the skull by three elements; the parietal, the quadratojugal, and the jugal. The intercalare occupies a position on the external edge of the exoccipital, and nearly approaches the proximal end of the quadrate at its posterior side. The postfrontals and prefontals are well developed, and the parietals, frontals, nasals and premaxillaries form the middle line of the skull above, as in other reptiles. The elements of the lower jaw belonging to reptiles are all present.

Subordinal and Family Characters.—The *parietal* is, as to its superior face, a T-shaped bone, of which the transverse portion rests on the supraoccipital bone, without interspace. The external extremities of the transverse branches are excavated below to receive the proximal end of the quadrate. These extensions of the parietal are stout, and represent the parietosquamosal arch of the *Lacertilia*. Resting as they do on the occipital, they present a character exactly intermediate between those presented by the *Crocodilia* and *Lacertilia*.

The *zygomatic arch* is complete, having the usual flexure observed in reptiles, and branching to a postorbital arch by the intervention of a postorbital bone. The postorbital part of the zygomatic arch forms the external border of the superior aspect of the skull, and encloses a crotaphite foramen. The portions of the frontal and parietal bones which separate the crotaphite foramina, form a narrow isthmus. The postorbital part of the zygoma consists chiefly of the squamosal. This element is rod-like, and does not reach or take part in the articulation with the quadrate. In this respect this genus differs materially from *Scelidosaurus*, where, according to Owen, the squamosal is more extended posteriorly, and articulates with the superior part of the quadrate by a fixed articulation. The external portions of the parietal are thus, in *Scelidosaurus*, correspondingly reduced.

The *malar* or *jugal* bone is of large size, while the quadrato-

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[1] Proceedings Phila. Academy, 1876, October.

jugal is rather small. Its articulation with the quadrate is squamosal. The maxillary is convex on its outer face, presenting the teeth inwards. The nasals are distinct, and much narrowed forwards to their junction with the spines of the premaxillaries. The latter bones are distinct. They form, when viewed from above, an anchor-shaped bodv, with the curved flanges extending outwards and backwards. These enclose, with the anterior apex of the maxillaries, the huge external nareal orifices, which were probably roofed over by membrane, as in the birds.

The *pterygoids* extend well posteriorly as broad plates, and are in close contact with the inferior part of the quadrates. They are separated for a short distance on the middle line posteriorly by a fissure, which, with the narrow space between the pterygoids and the presphenoids, gives exit to the transversely narrowed posterior nares. The occipital condyle looks downwards. The sphenoid is posteriorly horizontal, and overlaps the basioccipital with only a trace of lateral tuberosities; but in front it is curved abruptly downwards. At this point, an elongate, flattened, truncate process extends posteriorly, forming the median part of the roof of the fissure of the posterior nares. In front of this fissure the pterygoids are in contact, and extend a considerable distance anteriorly; at least to opposite to the border of the large anterior palatomaxillary foramen.

The *maxillary* bone is produced far posteriorly, so as to define the zygomatic foramen on the inner side. The palatine bone extends posteriorly between it and the pterygoid for a considerable distance, when the expanding pterygoid cuts it off, and extends to the posterior extremity of the maxillary, closing the space occupied in the *Lacertilia* by the posterior palatomaxillary foramen. I cannot distinguish whether the portion which extends to the maxillary bone is distinguished as an ectopterygoid. The posterior edge of this part of the pterygoid projects below the posterior part of the bone, which is nearly horizontal until it reaches the quadrate. It then ascends, forming a lamina on the inner side of that bone, reaching the process from the inner side of the condyle.

The *vomer* is a narrowed, horizontal lamina between the anterior parts of the maxillary bones, anterior to which point it does not appear to extend. It soon becomes a vertical lamina, spreading at the base, where it is in contact with the middle line of contact of the pterygoid bones (and perhaps of the palatines, but these

are not visible at that point). From this point it is a deep attenuated keel, dividing the palate into two deep channels, and extends as far posteriorly as the nares. The posterior part is free beyond its base. The entire vomer is like that seen in various natatorial birds. The anterior maxillopalatine foramen separates the vomer from the maxillaries anteriorly. Posteriorly, the foramen is bounded by an ascending process of the maxillary bone, which is in contact with the palatines posteriorly.

The *premaxillary* is divided its whole length. At the middle line above, it passes between the nasal laminæ, while below it forms the roof of the muzzle part of the mouth, and the floor of the huge nareal fossa on each side of its spine. This part extends posteriorly as a thin lamina, each meeting that of the opposite side on the middle line, and recurving upwards, forming a median superior crest. The horizontal portion extends above the maxillary bone, between it and the descending postnareal part of the nasal, and extends over the anterior part of the lachrymal, intervening between the anterior extremity of the malar, and the posterior extremity of the nasal. Its posterior portion develops a rib-like projection, which descends downwards and forwards towards the anterior part of the maxillary bone, and disappears. This bone perhaps includes the *maxilloturbinal.*

The preorbital region includes a not unusual arrangement of the elements. The prefrontal bone descends as far as the middle of the anterior border of the orbit, and to the lachrymal. The orbital edge of the latter is interrupted by an element which presents a vertical edge outwards, and appears to be distinct from it, extending under it anteriorly, and separated from it by a vertical groove externally. It is, perhaps, the superciliary bone of Cuvier, which occupies a somewhat similar position in the *Varanidæ.* Below the lachrymal a small part of the orbit is bounded in front by the jugal. The latter sends forward a laminar prolongation over the maxillary, separating it externally from the posterior extension of the maxilloturbinal.

The *mandibular ramus* includes all the elements of the reptilian jaw. The arrangement posteriorly is a mixture of that of the crocodile and that of the lizard, while the remaining portion is peculiar. The angle is formed by about equal parts of the articular and angular, the former furnishing the external half, the latter the internal. There are a huge dental fossa and foramen, as in the

Lacertilia, and no perforations either external or internal, in agreement with the same type. The coronoid process is very large and elevated, and its base, which is crescentic in section, is embraced by the surangular, and is reached posteriorly by the anterior prolongation of the articular. Its posterior face is concave, and its apex is curved anteriorly, reaching the superior edge of the jugal bone at the inferior border of the orbit. The angular bone forms the internal border of the dental fossa, and extends to the posterior edge of the splenial above. Below, it sends a prolongation forwards. The greater part of the external and inferior faces of the ramus are formed by the surangular bone, which has an enormous extent, far exceeding in size that of any known reptile. It extends posteriorly to below the quadrate cotylus. Anteriorly it spreads laterally, and unites with its fellow of the opposite side, forming a short symphysis, and simulating a dentary. At the base of the internal side of the ramus, it is separated from the anterior prolongation of the angular by an open Meckelian groove, which shallows out near the middle of its length. In correspondence with this extent of the surangular, the splenial is enormously developed, and contains the great magazine of teeth which I have described as characteristic of this type.[1] Its internal wall is very thin, and adheres closely to the faces of the teeth, in the fossil, in its present condition. This development and dentition of the splenial bone distinguishes the *Hadrosauridæ* widely from the *Iguanodontidæ*. The dentary bone is a flat semicircular plate attached by suture to the extremities of the surangulars. There is no trace of symphysial suture, and the posterior border sends a median prolongation backwards, which is embraced by the surangulars. The edge of the dentary is flat, thin, and edentulous, and closes within the edge of the premaxillary.

The dentition is remarkable for its complexity, and for the difference in character presented by the superior and inferior series. Leidy pointed out the character of the latter[2] in the *Hadrosaurus foulkei*, and I have described the character of the superior dentition in the genera *Cionodon*[3] and *Diclonius*.[4] The teeth of both

[1] Bulletin U. S. Geol. Survey Territories, F. V. Hayden; iii, p. 594–7. May, 1877.

[2] Cretaceous Reptiles North America, 1864, p. 83.

[3] Vertebrata of Cretaceous formations of the West, 1875, p. 59.

[4] Proceedings Philadelphia Academy, 1876, p. 250.

series succeed each other in columns of from five to eight teeth each, following an arc of a circle. The superior arc is convex externally; the inferior arc is convex internally, or towards the position of the tongue. It results that the opposed grinding surfaces of the two dental series are vertical. The cementum-plate of the tooth is, in both sets, on the convex side of the tooth, hence external and inferior in the superior teeth, and internal and superior in the inferior teeth. The teeth replace each other differently in the two jaws, or rather the replacement of the teeth does not partake of the general reversal of relations which the opposite series present in all other respects. The successional teeth rise in both jaws on the inner sides of the older teeth. From this it follows, that in the superior series the replacement is on the non-functional side of the tooth, or from the side which does not bear the cementum-plate. In the lower jaw, the successional teeth follow on the side that bears the cementum-plate, so that one tooth must be worn away before the apex of its successor can come into use. The arrangement of the superior series permits the successional to overlap the functional tooth far beyond the base of the enamel-plate, which in point of fact they do in the *Diclonius mirabilis*, though not to the same extent as in the *Cionodon arctatus*. The superior teeth are smaller and narrower in form than the inferior, and both have a keel on the median line of their cementum-face. There are no teeth on the anterior parts of the surangular bone nor on the dentary or premaxillary bones. The extremity of the muzzle is a flattened spatulate beak.

Dermal or corneous structures have left distinct traces in the soft matrix about the end of the beak-like muzzle. Laminæ of brown remnants of organic structures were exposed in removing the matrix. One of these extends as a broad vertical band round the sides, indicating a vertical rim to the lower jaw, like that which surrounds some tea trays, and which probably represents the tomia of the horny sheath of a bird's beak. At the front of the muzzle its face is sharply undulate, presenting the appearance of vertical columns with tooth-like apices. Corresponding tooth-like processes, of much smaller size, alternate with them from the upper jaw. These probably are the remains of a serration of the extremital part of the horny tomia, such as exist on the lateral portions in the lamellirostral birds.

Systematic Results.—The structure of the skull of this species adds some confirmation to the hypothesis of the avian affinities

of the *Dinosauria*, which I first announced, as indicated by the hind-limbs, and which Professor Huxley soon after observed in the characters of the limbs and pelvis. The confirmation is, however, empirical rather than essential, and is confined to a few points. One of these is the form and position of the vomer, which much resembles that seen in lamellirostral birds. The large development of the premaxillary bone has a similar significance. So has the toothless character of that bone and the dentary.

Among reptiles, this skull combines, in an interesting way, the characters of the two orders *Crocodilia* and *Lacertilia*. The presence of the ethmoid above the maxillary and overlapping the lachrymal, is unique among vertebrata, so far as I am aware. The free exoccipito-intercalare hook is scarcely less remarkable.

Of mammalian affinity there is no trace to be found.

Specific Characters.—The general form and appearance of the skull, as seen in profile, is a good deal like that of a goose. From above it has more the form of a rather short-billed spoonbill (*Platalea*). For a reptile, the head is unusually elevated posteriorly, and remarkably contracted at the anterior part of the maxillaries. The flat, transverse expansion of the premaxillaries is absolutely unique. The posterior edges of the occipital bones are produced far backwards, forming a thin roof over the anterior part of the vertebral column. This roof is supported by two strong buttresses, one from each side of the foramen magnum. The latter is a vertical oval. The exoccipital (carrying the intercalare) descends on each side, forming a free hook-like process behind the superior half of the quadrate. The recurved process of the lateral branches of the parietal underruns the squamosal two-thirds the length of the latter. The quadrate is separated by a rather narrow, obliquely vertical fossa, from the postorbital arch, owing to the posterior position of the latter.

The orbit is posterior in position, and is a horizontal oblong in form. The superior (superciliary) border is flat, with slight rugosities at the positions of the pre- and postfrontal sutures. The frontal region is a little concave, and there is a convexity of the superior face of the prefrontal bone in front of the line of the orbit. The peculiar position of the teeth gives the side of the face, when the mandible is closed, a horizontally extended concavity. There are four and a half tooth-like colums on each side of the middle line of the end of the muzzle.

The extremital teeth of both series are smaller than the great majority, which are of equal size and similar form. Those of the superior series are rod-like, narrowed at the extremities, and flattened on one side. The edges of the cementum-plate are not serrate, and the other faces of the tooth are finely rugose with cementum-granules. In the inferior series, the cementum-faces are diamond-shaped, and the tooth may thus be distinguished into crown and root. The concealed surfaces are finely rugose; the edges of the cementum-plate are not serrate, and its surface is smooth. As compared with the *Hadrosaurus foulkei*, the dental magazine is much deeper, and contains a greater number of teeth in a vertical column, and probably a larger number in the aggregate. I find in each maxillary bone of the *Diclonius mirabilis* six hundred and thirty teeth, and in each splenial bone four hundred and six teeth. The total number is then two thousand and seventy-two.

According to Mr. Wortman, who, with Mr. Hill, dug the skeleton out, its total length is thirty-eight feet. The length of the skull is 1·180 meters.

Restoration.—This animal in life presented the kangaroo-like proportions ascribed by Leidy to the *Hadrosaurus foulkei*. The anterior limbs are small, and were doubtless used occasionally for support, and rarely for prehension. This is to be supposed from the fact that the ungual phalanges of the manus are hoof-like, and not claw-like, though less ungulate in their character than those of the posterior foot. The inferior presentation of the occipital condyle shows that the head was borne on the summit of a vertical neck, and at right-angles to it, in the manner of a bird. The head would be poised at right-angles to the neck when the animal rested on the anterior feet, by the aid of a U-like flexure of the cervical vertebræ. The general appearance of the head must have been much like that of a bird.

The nature of the beak and the dentition indicate, for this strange animal, a diet of soft vegetable matter. It could not have eaten the branches of trees, since any pressure sufficient for their comminution would have probably broken the slightly attached teeth of the lower jaw from their places, and have scattered them on the floor of the mouth. It is difficult to understand also how such a weak spatulate beak, could have collected or have broken off boughs of trees. By the aid of its dentate horny edge

it may have scraped leaves from the ends of branches, but the appearances indicate softer and less tenacious food. Could we suppose that the waters of the great Laramie lakes had supplied abundant aquatic plants without woody tissue, we would have the condition appropriate to this curious structure. Nymphæas, Nuphars, Potamogetons, *Anacharis*, *Myriophyllum* and similar growths could have been easily gathered by this double-spoon-like bill, and have been tossed, by bird-like jerks of the head and neck, back to the mill of small and delicate teeth. In order to submit the food to the action of these vertical shears, the jaws must have been opened widely enough to permit their edges to clear each other, and a good deal of wide gaping must, therefore, have accompanied the act of mastication. This would be easy, as the mouth opens, as in reptiles and birds generally, to a point behind the line of the position of the eye. The eye was evidently of large size. On the other hand the indications are that the external ear was of very small size. There is a large tract that might have been devoted to the sense of smell, but whether it was so or not is not easily ascertained.

We can suppose that the huge hind-legs of this genus and of *Hadrosaurus* were especially useful in wading in the water that produced their food. When the bottom was not too soft, they could wade to a depth of ten or more feet, and, if necessary, drag aquatic plants from their hold below. Fishes might have been available as food when not too large, and not covered with bony scales. Most of the fishes of the Laramie period, are, however, of the latter kind (genus *Clastes*). The occurrence of several beds of lignite in the formation shows that vegetation was abundant.

EXPLANATION OF PLATES.

(All the figures are one-seventh of the natural size.)

PLATE IV. Side view of skull of *Diclonius mirabilis*.

PLATE V. The same viewed from above.

PLATE VI. Inferior view of the same.

PLATE VII. Fig. 1, View of occipital region of the same. Fig. 2, View of the extremity of the muzzle from the front.

The complete iconography of this species will appear in the third volume of the Report of the United States Geological Survey of the Territories, under F. V. Hayden and J. W. Powell, now in course of preparation.

ON SOME VERTEBRATA FROM THE PERMIAN OF ILLINOIS.

BY E. D. COPE.

The first notice of the existence of the Permian formation in Illinois was published in these Proceedings for 1876, p. 404, *et seq.* I then described the genera *Cricotus* and *Clepsydrops*, and a species of fish allied to *Ctenodus*. In the Proceedings of the American Philosophical Society for 1877 (commencing at p. 52), I added descriptions of other species, and in a second paper in the same volume, p. 182, I showed that the entire number known to that date was seventeen. Since then Mr. William Gurley, of Dansville, Ill., has sent me some additional specimens, which increase our knowledge of this interesting fauna.

A tooth in the collection is an incisor of a species of the *Diadectidæ*, a family not hitherto recognized in Illinois, although I have recorded it from Texas and New Mexico. It is more slender than the corresponding teeth of any of the species known to me. I do not know the incisors of the *Chilonyx rapidens*. I note here that the genus *Phanerosaurus* von Meyer, from the Permian of Germany, probably belongs to the *Diadectidæ* or the *Bolosauridæ*. The vertebræ are a good deal like those of *Empedias*,[1] but apparently lack the hyposphen.

Didymodus (?) **compressus** Newberry. *Diplodus* (?) *compressus* Newb. Cope, Proceeds. Amer. Philos. Soc., 1877, 53.

The name *Diplodus* was used by Rafinesque for a valid genus of fishes before it was employed by Agassiz for the present genus. I therefore propose to substitute for it the name *Didymodus*.

Thoracodus emydinus gen. et sp. nov.

Char. gen.—The form of the tooth or jaw on which this genus is proposed, reminds one of that of a *Diodon*, and also of one-half of that of a *Janassa*. It appears to be the half of a bilateral plate. which is divided on the middle line by suture. Its form is somewhat that of the anterior part of an episternal bone of a tortoise. It consists essentially of a smooth border, separated from the remainder of the tooth by a transverse groove. The interior

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[1] Mittheilungen a. d. Koeniglich. Mineral., Geolog. u. praehistor.-Museum, Dresden; V, Nachträge zur Dyas; Geinitz und Deichmüller, 1882, p. 10.

portion is, on the superior face (if the piece belong to the inferior jaw, and *vice versa*), transversely ridged and grooved, after the manner of the genus *Janassa.*

Char. specif.—The smooth border is wide above and below. Its edge is produced into a median projection, which is decurved. On the inferior surface it is marked by shallow grooves, which radiate from the groove which bounds it posteriorly, extending nearly to the free edge. Posterior to the bounding groove, the surface is smooth. The posterior surface above has its grooves concentric with the curved free margin. The ridges are narrow, and step-like in position, presenting their free edges backwards. There are no grooves other than these steps. They have an angular curve opposite to the angle of the free margin, and at the angle the groove which separates them is narrowed, while it widens at other points. Free edge of border thickened; surface everywhere smooth.

Measurements.	M.
Length of fragment transversely, . . .	·014
Length of fragment anteroposteriorly, . .	·011
Width of border area at median suture, . .	·005
Seven cross-ridges, ...	·005
Thickness at suture at cross-ridges, . .	·002

Ctenodus heterolophus sp. nov.

This species is represented by a single broken tooth, which presents remarkable characters. It had apparently, when perfect, but three crests, which differ greatly in length, diminishing very rapidly from the first or marginal crest.

The crest just mentioned is not only longer, but *much more* elevated than the others, except at the base, where the second crest is the highest. But while the first rapidly rises, the second retains its elevation, and then descends, forming a convex edge, of which the distal part is obtusely serrate. The proximal part of the first crest is worn by friction with the opposing edge of the opposite jaw into a sharp edge, below which its base is covered by a thin layer of the shining cementum which invests the teeth and sides of the second crest. The amount of this shining layer is thus more extensive than in any other species of *Ctenodus* known to me. The third crest, judging by its base of continuity with the second, is very small.

Measurements.	M.
Elevation of first crest at middle, . .	·0095
Elevation of second crest at middle, . .	·0065
Length of a tooth of second crest, . .	·0020

The peculiarities of this tooth suggest that the genus *Gnathorhiza* Cope (Proceedings Amer. Philos. Soc., 1882, p. 629) is Dipnoan, and allied to *Ctenodus.*

Ctenodus vabasensis sp. nov.

This fine species is represented by an almost perfect tooth. It is allied to the *C. fossatus* Cope, but is wider, and the crests do not radiate so equally, but are chiefly directed in one direction as in most species of the genus. The *C. gurleianus* and *C. pusillus* are at once distinguished by the small number of crests, while the *C. periprion* and *C. dialophus* have a larger number of crests, and are otherwise different. *C. porrectus* differs less from it, but has only five $\frac{1}{1}$ crests, while the *C. vabasensis* has six $\frac{1}{1}$. The $\frac{1}{1}$ represents the small posterior (?) crest, which is double. This, with the next one, is directed slightly posteriorly; the fifth is at right-angles to the long axis, and the anterior four extend more or less forwards. They are serrate nearly to their bases, but the teeth are obsolete on their basal halves. The straight part of the internal edge extends as far forwards as the fourth crest, and is continued posteriorly as a short process. No fossæ at ends of crests. Superior face of tooth wide, and slightly concave. The anterior parts of the first and second crests are broken away, so that it is impossible to say whether they are produced as in *C. porrectus.*

Measurements.	M.
Length to marginal base of second crest, . .	·024
Width at marginal base of second crest, . .	·009
Width at fourth crest, inclusive of apex, . .	·015
Width of posterior side, ...	·010
Thickness at base of fifth crest, ...	·005

MAY 15.

The President, Dr. LEIDY, in the chair.

Twenty-five persons present.

The following were presented for publication:—

"Pinus Koraiensis," by Josiah Hoopes.

"On the Fishes of the Lakes of the Western Part of the Great Basin," by Edw. D. Cope.

Observations on Forsythia.—Mr. THOMAS MEEHAN, at the meeting of the Botanical Section, May 14, referred to his communication to the Academy (December 29, 1868), in which he suggested that notwithstanding the strong specific differences between *Forsythia viridissima* and *F. suspensa*, he believed they must have had a common origin. *F. suspensa* has short styles and long stamens, broad lobes to the corolla, broadly-ovate, thin, glaucous, sometimes trifoliate, deeply serrate leaves, and makes a shrub of some ten feet high, with numerous slender, pendulous branches. *F. viridissima* is a stiff, erect bush, but of not half the height, with narrowly lanceolate, thick, bright green, lightly serrate leaves; flowers with narrow lobes, and the style long and the stamens short. *F. suspensa*, in cultivation, often produces abortive capsules; *F. viridissima* rarely, if ever. In the paper cited above, an account is given of the production of seed-vessels on *F. viridissima*, by using the pollen of *F. suspensa*. Though the seeds were not wholly perfect, a winged seed of one species was produced among the wingless ones of the other. The resultant impression from those observations was that in spite of what would be regarded as good specific differences, they are but dimorphic forms, referable to sexual peculiarities.

Three years ago, the usually seedless capsules of *F. suspensa* produced a number of good seeds, which were sown. This season thirty-four flowered. The leaves and general habit of these plants present every shade of gradation between *F. suspensa* and *F. viridissima;* some of the leaves of the latter being even much more slender than those of the original species. The flowers also present in the larger number of cases the slender lobes of the *F. viridissima;* some with the lobes recurved laterally to such an extent as to seem much narrower than they are.

The most interesting fact in connection with this is the sexual characteristics. Of the thirty-four plants, raised from a parent having a short style and long stamens, only four have retained this parental character, but have assumed that belonging to the form *viridissima*.

Some interesting questions are suggested by these observations:

The fact that *F. suspensa* makes abortive capsules freely, and *F. viridissima* rarely, though it has the best developed pistil, indicates that fertility is dependent on the potency of the pollen; and this is confirmed by the production of capsules on *F. viridissima* when the pollen of *F. suspensa* was applied:

The fact that the speaker has had both forms growing on his grounds for many years, without any seed-vessel appearing on *F. viridissima*, except in the case cited, shows that it is not likely to be cross-fertilized through insect agency.

In the fully fertile case of *F. suspensa*, the plants of *F. viridissima* were fully four hundred feet away; and the suggestion of intercrossing between these forms, considered in connection with the points previously made, seems to place hybridization out of the question.

We may conclude, therefore, that these two supposed species are but sexually dimorphic forms of one; and we have also the curious fact that, in this case, notwithstanding the presumable influence of the law of heredity, the strongly masculine tendency of the parent, as indicated by the highly developed stamens, the potency of its pollen on the *F. viridissima*, the power to almost perfect seeds in partially developed seed-vessels generally, and the actual perfection in one year, notwithstanding the imperfectly developed pistil, should have had to give way to the female tendency in the offspring to such a great degree as to leave only four out of thirty-four to represent the parent.

Influence of Circumstances on Heredity.—Mr. THOMAS MEEHAN referred to the fact that seed of the purple-leaved variety of *Berberis vulgaris*, collected from plants growing near Philadelphia, reproduced the purple-leaved peculiarity to an extent which it could not do more perfectly if the variety were a true species. In a bed of seedlings, containing on an estimate one thousand plants, there were only two reversions to the original green-leaved condition. Two years ago, he had been given, by Prof. C. S. Sargent, some seeds of ligneous plants, sent to him from some European Botanical Garden, and of thirty seedlings planted only two are dark purple as in the parent.

MAY 22.

Rev. Dr. H. C. McCOOK, Vice-President, in the chair.

Forty persons present.

A paper entitled "A Revision of the Species of Gerres found in American Waters," by B. W. Evermann and Seth E. Meek, was presented for publication.

MAY 29.

The President, Dr. LEIDY, in the chair.

Forty persons present.

N. A. Randolph, M. D., J. Reed Conrad, M. D., and Spencer Trotter, M. D., were elected members.

Arnould Locard, of Lyons, Fred. W. Hutton, of Christchurch, N. Z., and C. E. Beddome, of Hobart Town, Tasmania, were elected correspondents.

The following were ordered to be printed:—

PINUS KORAIENSIS Sieb. & Zucc.

BY JOSIAH HOOPES.

Through the kindness of Chief Eng. G. W. Melville, U. S. N., I have enjoyed an opportunity of studying some excellent specimens of this interesting species of pine, collected by him during the late voyage of the unfortunate "Jeannette" to the Arctic regions. These specimens consist of a branch clothed with foliage, two immature cones, and a few mature seeds, and were collected in the District of Tuknansk, in Eastern Siberia. It was seen along the banks of the Lena, Yenisei and Obi Rivers, forming a tree about thirty feet in height, with a trunk about ten inches in diameter at base. The collector further states that it fruits abundantly, and "the edible seeds are used by the natives as food, and by travelers as nuts." It is interesting to note that this heretofore comparatively rare species has a wider habitat, and is more numerous than has generally been supposed, although reported as having been found up to the Amoor River, which takes its rise in the mountain range dividing the Lena from the Amoor; hence it was reasonable to suppose it was more generally distributed throughout Siberia and adjacent islands. Siebold found it in Kamtschatka; and various authors have described it in the list of Japanese Coniferæ, but only in the latter as an introduced species, where it is said to be quite rare.

Pinus Koraiensis is placed by Dr. Engelmann, in his recent revision of the genus *Pinus*, in the subsection Cembræ, of his first section, Strobus. It is distinguishable from the section Eustrobi by reason of the parenchymatous ducts, and with leaves sparingly serrulate, scarcely denticulate at tip. This nut-bearing pine is well marked throughout, and especially so in its cones and seeds, the latter being wingless, subangulate, flatly compressed, leaving on both sides of the scale when removed, remarkably deep impressions. The cones are very distinctive, with long reflexed scales, terminating in an abrupt mucro-like apex. The leaf-characters in the specimens before me coincide with the published description given by Dr. Engelmann, in relation to the absence (or nearly so) of hypoderm or strengthening-cells, as well as in other peculiar features of the Cembran group.

Murray, in his "Pines and Firs of Japan," records its height from ten to twelve feet, yet Parlatore, on the authority of Perfetti, gives it at "sometimes thirty to thirty-three feet." The latter is corroborated by Chief Eng. Melville, thus showing conclusively that it is a true northern species, attaining only its greatest size near the extreme limits of arboreal vegetation; and yet, like all other species of nut-pines, it never forms a large-sized tree.

This species will no doubt make a valuable addition to our list of ornamental Conifers, as its hardiness is unquestioned, and the foliage is as attractive as any other of the White Pine group, unless we except the *P. excelsa*. In England it has proven reliable, and with us the small plants show evidences of success.

A REVIEW OF THE SPECIES OF GERRES FOUND IN AMERICAN WATERS.

BY B. W. EVERMANN AND SETH E. MEEK.

Upon attempting to identify various specimens of *Gerres* from different points on our coast, and from Mexico and Central America, we were led to the thought that the species of this genus have been unduly multiplied.

Through the kindness of Prof. D. S. Jordan, to whom we here desire to acknowledge our indebtedness for the use of specimens and his library, and for many valuable suggestions, we had placed at our disposal his entire collection of specimens of *Gerres*, thus affording us a considerable amount of material for purposes of comparison.

In Jordan and Gilbert's Synopsis of Fishes of North America, six species of *Gerres* are given as found on the United States Coast; of these, *G. homonymus* appears to us to be identical with *G. gula* C. and V.; and *G. harengulus* Goode and Bean, with *Eucinostomus pseudogula* of Poey, and with *Diapterus gracilis* described from Cape San Lucas by Dr. Gill.

In the present paper it is desired to set forth the conclusions reached from a study of the material in hand. These conclusions are all to be considered as provisional, perhaps to be modified by the study of a greater number of specimens.

The synonymy given, however, appears to be fully justified by the evidence before us.

We have been kindly permitted to copy the synonymy of the Pacific Coast species from Profs. Jordan and Gilbert's MSS.

The different species of *Gerres* noticed in this paper may be readily separated by the following analysis:—

a. Preopercle and preorbital entire; body elongate, depth $2\frac{1}{3}$ to 4 in length.
- *b.* Premaxillary groove naked.
  - *c.* Anal rays II–8; body very elongate, depth less than one-fourth its length. *lefroyi.* 1.
  - *cc.* Anal rays III–7.
    - *d.* Premaxillary groove linear.
      - *e.* Eye small, about $3\frac{1}{6}$ in head; depth nearly 3 in length. *gracilis.* 2.
      - *ee.* Eye large, less than 3 in head; depth about $2\frac{2}{3}$ in length. *dowi.* 3.

dd. Premaxillary groove not linear.

e. Body slender, depth 3 to $3\frac{1}{2}$ in length. *jonesi.* 4.

ee. Body somewhat elevated, depth about $2\frac{1}{2}$ in length.

f. Caudal fin moderate, shorter than head; second anal spine not very strong, shorter than third, $\frac{1}{4}$ to $\frac{1}{3}$ length of head; ventrals short, little more than half length of head, not reaching vent. Color bright silvery, darker above; snout and upper edge of caudal peduncle somewhat dusky; dark punctulations on body few or none; no trace of vertical bars; upper part of spinous dorsal becoming gradually blackish, other fins nearly plain; axil faintly dusky. *californiensis.* 5.

ff. Caudal fin about as long as head; second anal spine very strong, longer than third, one-third or more length of head; ventrals long, two-thirds length of head, reaching vent. Color in life, clear silvery, bluish above, sides with obsolete longitudinal streaks; back and sides with 8 or 9 bluish vertical bars, about as broad as the pupil; a dark blotch on upper edge of eye. *cinereus.* 6.

bb. Premaxillary groove scaled in front, forming a naked pit behind; depth about $2\frac{2}{3}$ in length. *gula.* 7.

aa. Preopercle serrate; premaxillary groove broad.

b. Preorbital entire.

c. Premaxillary groove naked.

d. Body ovate, the outline somewhat regularly elliptical, depth a little less than half length; spines rather slender and short, second dorsal spine half length of head, second anal spine less than half length of head. *aureolus.* 8.

dd. Body rhomboid, short and deep, with angular outlines, the depth usually more than half length; spines long and strong.

e. Anal rays III–8; second dorsal spine three-fourths or more length of head; second anal spine more than half length of head. *peruvianus.* 9.

ee. Anal rays II–9; second dorsal spine not nearly so long as head, and not half longer than second anal. *rhombeus.* 10.

cc. Premaxillary groove broad, rounded behind, with a median linear depression, its surface scaled; anal rays III–8; second dorsal spine about as long as head; pectorals nearly as long as head, reaching front of anal; teeth long, slender, and brush-like; depth 2 in length. *olisthostoma.* 11.

bb. Preorbital serrate; body with distinct dark stripes along the rows of scales; body rhomboidal, with angular outline; spines very strong.

c. Ventrals blackish. *patao.* 12.

cc. Ventrals pale.

d. Second dorsal spine $\frac{2}{3}$ to $\frac{3}{4}$ length of head, and $\frac{2}{7}$ depth of body, which is 2 to $2\frac{2}{5}$ in its length.

e. Pectorals long, reaching about to front of anal; caudal longer than head; lateral stripes numerous; depth nearly 2 in length. *lineatus.*[1] 13.

ee. Pectorals short, barely reaching vent; caudal shorter than head; lateral stripes few; depth about $2\frac{2}{5}$ in length. *brevimanus.* 14.

dd. Second dorsal spine as long as head, and longer than longest anal spine; pectorals narrow, reaching past tips of ventrals to anal; lateral stripes about 12; depth 2 to $2\frac{1}{4}$ in length. *plumieri.* 16.

1. **Gerres lefroyi** (Goode) Günther.

Diapterus lefroyi Goode, Am. Jour. Sci. & Arts, 123, 1874.

Eucinostomus lefroyi Goode, Bull. U. S. Nat. Mus., No. 5, 39, 1876.

Eucinostomus productus Poey, Ann. Lyc., xi, 59, 1876.

Gerres lefroyi Günther, Voyage of Challenger, Fishes, i, 10, 1880. (Name only.)

Habitat.—Bermuda Islands.

2. **Gerres gracilis** (Gill) Jordan & Gilbert.

Diapterus gracilis Gill, Proc. Ac. Nat. Sci. Phila., 246, 1862. (Cape San Lucas.)

Gerres aprion Günther, iv, 255, 1862. (San Domingo; Jamaica; Bahia.)

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[1] The short description of *Gerres brasilianus* C. and V., vi, 458, contains no characteristics by which we are able to distinguish it from either *G. lineatus* or *G. brevimanus*, hence we do not include it in the Key.

Eucinostomus pseudogula Poey, Anal. Soc. Esp., iv, 124 & 125, 1875. (Cuba.)

Eucinostomus harengulus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 132. (Western Florida.)

Diapterus harengulus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 339. (Clear Water Harbor, Florida.)

Gerres gracilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas); and Bull. U. S. Fish Comm., 1881, 329 (Guaymas; Mazatlan; Panama); *ibid.*, 1882, 108 (Mazatlan; Panama).

Gerres harengulus Jordan & Gilbert, Syn. Fish. N. A., 584, 1883. (Pensacola, Florida.)

Body elliptical, compressed, tapering regularly each way from the spinous dorsal; anterior profile almost straight and not steep; angle at front of breast little marked. Mouth small, maxillary reaching vertically from front of orbit or slightly past it. Teeth rather strong, in broad patches. Exposed portion of maxillary ovate, about twice as broad as long. Preorbital entire, very narrow, its narrowest part about half width of maxillary. Eye not very large, its diameter about equal to length of snout, or the interorbital space, and is about 3½ in head. Furrow for the base of the premaxillaries a narrow naked groove, its length about three-fifths of the eye, and more than three times its own breadth, measured from the anterior limit of the scales along its sides. Preopercle entire. Dorsal spines weak and flexible, the last two or three proportionally stronger than the others. Longest dorsal spine about twice in head, more than two-fifths greatest depth of body, and nearly twice length of second anal spine. Anal spines short, the second somewhat stronger than the third, but shorter, its length 3¾ to 4½ in head. Third spine shorter than soft rays. Ventrals short, three-fifths length of head, reaching about half-way to anal, but not nearly to vent. Pectorals slender, about as long as head, reaching about to vent. Caudal not very long, the inner margins of the lobes convex, the middle rays about one-fourth length of outer ones, which are a little shorter than head. Scaly sheath at base of fins moderate, the last rays of the anal hidden by it. Ventrals and caudal mostly covered with small scales; other fins naked.

Color in life, silvery, greenish above. Snout and upper part of caudal peduncle dusky. Spinous dorsal, in a male specimen, dusky, punctate at base, abruptly black at tip, the dark areas separated by a transparent, horizontal bar; in a female specimen, the dorsal grows gradually darker at tip. Soft dorsal punctate.

Caudal with a faint dusky margin. Ventrals very slightly dusky on the middle in the male, plain in the female.

Head $3\frac{3}{10}$; depth $2\frac{9}{10}$; D. IX–10; A. III–7; lat. line 5-45-9.

It seems probable that the habitat of the various species of *Gerres* will be found to be much more extended than has hitherto been supposed. Specimens of the present species have been obtained in the West Indies, on the coast of Florida, and at several points on the Pacific coasts of Central America and Mexico. Prof. Chas. H. Gilbert reports it as abundant at Mazatlan, where it is found in shallow waters near the shore. It reaches a length of six inches or more, and is known to the fishermen as *Mojarra cantileña.*

3. **Gerres dowi** (Gill) Günther.

Diapterus dowi Gill, Proc. Ac. Nat. Sci. Phila., 162, 1863. (Panama.)

Gerres dowi Günther, Fish. Centr. Amer., 448, 1866 (Description taken from Gill); Steindachner, Ichth. Beiträge, iv, 13, 1875 (No description). (Callao, Peru; Galapagos Islands).

Gerres dowi Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 329 (Panama); *ibid.*, 1882, 111 (Panama); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 377 (Panama).

Gerres aprion Günther, Fish. Centr. Amer., 391, 1866. (Name only.) (Panama.)

Habitat.—Panama to Peru. Very abundant on the coasts of the Galapagos Islands. (Steindachner.)

4. **Gerres jonesi** Günther.

Gerres jonesi Günther, Ann. and Mag. Nat. Hist., 1879, iii, 150, 389; Voyage Challenger, Fishes, i, 10, 1880 (Bermuda).

Habitat.—Bermuda Islands.

5. **Gerres californiensis** (Gill) Jordan & Gilbert.

Diapterus californiensis Gill, Proc. Acad. Nat. Sci. Phila., 1862, 245. (Cape San Lucas.)

Gerres californiensis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 319 (Guaymas; Mazatlan); *ibid.*, 1882, 108 (Mazatlan).

? *Gerres gula* Steindachner, Ichth. Beiträge, iii, 60, 1875. (Name only; *nec* Cuv. & Val.) (Magdalena Bay.)

Habitat.—Pacific coast of Mexico. (Mazatlan; Guaymas; Cape San Lucas.)

6. **Gerres cinereus** (Walbaum) Jordan & Gilbert.

Turdus cinereus peltatus Catesby, pl. ii, fig. 2, 1750.

Mugil cinereus Walbaum, Arte di Piscium, 228, 1792. (After Catesby.)

Gerres aprion Cuv. & Val., vi, 461, 1830 (Martinique; San Domingo; Montevideo; East Coast of Mexico). (Not of Günther — *Eucinostomus pseudogula* Poey); Poey, Rep. Fis. Cuba, i, 316, 1865.

Diapterus aprion Poey, Syn. Pisc. Cuba, 321, 1868. (Cuba.)

Gerres zebra Müller & Troschel, Schomburgk Hist. Barbadoes, 668, 1848 (Barbadoes); Günther, i, 343, 1859, and iv, 254, 1862 (Copied); Steindachner, Ichthyol. Notizen, iv, 11, 1867 (Surinam); Steindachner, Zur Fisch-Fauna des Magdelenen-Stromes, 9, 1878 (Rio Magdalena, identified with *G. squamipinnis*); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 329 (Mazatlan).

Gerres squamipinnis Günther, i, 349, 1859, and iv, 254, 1862 (Jamaica; Gautemala); Günther, Fish. Centr. Amer., 391, 1869 (No description) (Jamaica; Chiapam; Panama); Steindachner, Ichthyol. Notizen, iv, 12, 1867 (Surinam).

Gerres cinereus Jordan & Gilbert, Bull. U. S. Comm., 1882, 108 (Mazatlan); and Syn. Fish. N. A., 935, 1883.

Habitat.—Both coasts of Tropical America (Mazatlan; Chiapam; Panama; Bahamas; Barbadoes).

7. **Gerres gula** Cuvier & Valenciennes.

Gerres gula Cuv. & Val., vi, 464, 1830 (Martinique; Brazil); Jenyns, Zoöl. Beagle, Fishes, 58, 1842; Günther, i, 346, 1859, and iv, 255, 1862 (Atlantic Coasts of Tropical America); Poey, Rep. Fis. Cuba, i, 316, 1865.

Eucinostomus argenteus Baird & Girard, Ninth Smith. Report, 345, 1855; Baird & Girard, Mex. Bd. Survey, 17, pl. 9, figs. 9–12, 1859.

?*Gerres argenteus* Günther, iv, 256, 1862. (Atlantic Coasts of N.A.)

Eucinostomus gulula Poey, Anal. Soc. Esp., iv, 128, pl. vi, 1875.

Diapterus homonymus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 340. (Clear Water Harbor, Fla.)

Gerres gula Jordan & Gilbert, Syn. Fish. N. A., 934, 1883. (West Indies, north to Cape Cod.)

Body elliptical, compressed, dorsal profile tapering regularly each way from beginning of spinous dorsal; anterior profile nearly straight, posterior slightly more convex. Line from angle at front of breast to vent nearly straight. Mouth small, slightly oblique (when not protruded), maxillary reaching just beyond vertical at front of eye, exposed part triangular, about twice as long as broad. Premaxillaries very protractile; premaxillary groove longer than broad, scaled in front, with a naked pit behind; these scales, however, are not very distinct in young specimens, and are apt to be rubbed off in poorly preserved ones.

Villiform teeth on both jaws; no canines, incisors, or molars; no teeth on vomer or palatines. Preopercle entire; gill-rakers

short, about seven below angle. Eye large, 3 in head, its diameter a little greater than its distance from snout, and about equal to the interorbital space.

Scales moderate, as in other species. Lateral line follows curve of back, being most arched beneath fifth and sixth spines.

Spinous dorsal as long as soft, second dorsal spine nearly $1\frac{3}{4}$ in second anal spine, which is stronger than the third, but equals it in length; posterior ends of anal and dorsal fins opposite, soft parts of these two fins depressible into a scaly sheath. Pectorals nearly as long as head, reaching to vent. Ventrals short, not reaching quite to vent. Caudal deeply forked.

Color, in alcohol, silvery, palest below, no lines or bars except sometimes in young, but the scales are minutely punctate with dark, thickest on dorsal region. A black spot at top of spinous dorsal.

Head $3\frac{1}{4}$ in length; depth, $2\frac{5}{8}$. D. IX–10; A. III–7 or 8; Lat. line about 5–45–9.

We append averages of the measurements of thirteen specimens, viz.:—1 from Bermuda; 2 from Beaufort, N. C.; 2 from Charleston, S. C.; 7 from Pensacola, Fla.; 1 from Aspinwall.

From a comparison of these specimens and of some seven others which we have examined, we are convinced that the synonymy of this species should stand as given above.

TABLE OF MEASUREMENTS.

Number of specimens measured	1	2	2	7	1	
Specimens from	Bermuda.	Beaufort, N. C.	Charleston, S. C.	Pensacola, Fla.	Aspinwall.	Total average.
Greatest depth in length	2.77	2.81	2.67	2.61	2.67	2.66
Head in length	3.31	3.18	3.33	3.23	3.08	3.23
Distance from snout to spinous dorsal in length	2.71	2.50	2.51	2.42	2.39	2.46
Second anal spine in second dorsal spine	1.76	2.00	1.70	1.72	....	1.74
Eye in head	3.05	3.02	3.00	3.00	3.00	3.01
Depth of deepest specimen in length	2.77	2.77	2.63	2.33	2.67	....
Depth of most slender specimen in length	2.77	2.86	2.70	2.86	2.67	....
Shortest 2d anal in 2d dorsal spine	1.76	2.00	1.70	2.09	....	....
Longest 2d anal in 2d dorsal spine	1.76	....	1.70	1.54	....	....

8. **Gerres aureolus** Jordan & Gilbert.

Gerres aureolus Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 328 (Panama); *ibid.*, 1882, 111 (Panama).

Habitat.—Bay of Panama.

9. **Gerres peruvianus** Cuvier & Valenciennes. *Moharra, China.*

Gerres peruvianus Cuv. & Val., Hist. Nat Poiss., vi, 467, 1830 (Payta, Northern Peru); Lesson, Voyage Coquille, Poiss., 180, 1828; Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 330 (Mazatlan; Panama); *ibid.*, 1882, 111, 108, 112 (Panama; Mazatlan; Punta Arenas); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 382 (Panama).

Gerres rhombeus Günther, Fish. Centr. Amer., 391, 1866 (Name only; *nec* Cuv. & Val.) (Chiapam); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Salina Cruz).

Habitat.—West Coast of Tropical America (Mazatlan; Salina Cruz; Panama; Chiapam; Peru).

10. **Gerres rhombeus** Cuvier & Valenciennes.

Gerres rhombeus Cuv. & Val., vi, 459, 1830 (Martinique and San Domingo); Günther, iv, 258, 1862 (In part; apparently confounded with *G. olisthostoma* Goode & Bean) (Cuba; Jamaica; Puerto Cabello); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 382 (Aspinwall).

Habitat.—West Indies.

11. **Gerres olisthostoma** Goode & Bean. *Irish Pompano; Hog Fish.*

Gerres rhombeus Poey, Syn. Pisc. Cuba, 32, 1858 (Not *G. rhombeus* of Cuv. & Val, vi, 459); Poey, Rep. Fis. Cuba, i, 316, 1865.

Mojarra rhombea Poey, Anal. Soc. Esp., Hist. Nat., x, 327, 1881.

Gerres olisthostoma Goode & Bean, Proc. U. S. Nat. Mus., 1882, 428 (Indian River, Florida); Jordan & Gilbert, Syn. Fish. N. A., 934, 1883 (West Indies, north to Southern Florida).

Habitat.—West Indies, north to Southern Florida.

12. **Gerres patao** Poey.

Gerres patao Poey, Mem. Cub., ii, 192, 1860; *ibid.*, Syn. Pisc. Cub., 320, 1868; Günther, iv, 253, 1862 (Cuba).

Habitat.—West Indies.

13 **Gerres lineatus** (Humboldt) Cuvier & Valenciennes.

Smaris lineatus Humboldt, Observ. Zoöl., ii, 185, pl. 46, 1807–1834. (Acapulco.)

Gerres lineatus Cuv. & Val., Hist. Nat. Poiss., vi, 470, 1830 (Description from Humboldt); Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 330 (Mazatlan; San Blas); *ibid.*, 1882, 108 (Mazatlan); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 377 (Fresh-water lake at Acapulco).

Gerres axillaris Günther, Proc. Zoöl. Soc. Lond., 102, 1864; Günther, Fish. Centr. Amer., 448, 1866 (Chiapam); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Name only). (San Blas.)

Habitat.—West Coast of Mexico.

14. **Gerres brevimanus** Günther.

Gerres brevimanus Günther, Proc. Zoöl. Soc. Lond., 152, 1864; Günther, Fish. Centr. Amer., 448, 1869 (Chiapam).

Habitat.—Pacific Coast of Central America.

15. **Gerres brasilianus** Cuvier & Valenciennes.

Gerres brasilianus Cuv. and Val., vi, 458, 1830 (Brazil); Poey, Rep. Fis. Cuba, i, 315, 1865.

Habitat.—West Indies, south to coast of South America.

16. **Gerres plumieri** Cuvier & Valenciennes.

Gerres plumieri Cuv. & Val., vi, 452, 1830 (Antilles); Günther, iv, 253, 1862 (Atlantic Coasts of Tropical America); Jordan & Gilbert, Syn. Fish. N. A., 583, 1883 (West Indies, north to Eastern Florida); Poey, Rep. Fis. Cuba, i, 315, 1865.

Habitat.—West Indies; Aspinwall; Indian River, Fla.

Profs. Jordan & Gilbert's collection contains specimens from each of the two places last named.

JUNE 5.

The Rev. H. C. McCOOK, Vice-President, in the chair.

Twenty-five persons present.

A paper entitled "On the Genus Hyliota," by Graceanna Lewis, was presented for publication.

The death of Dr. W. Lehman Wells, a member, was announced.

Observations on Actinosphærium eichornii.—A communication from Miss S. G. FOULKE on *Actinosphærium eichornii* was read by Prof. H. Carvill Lewis.

It was stated that while observing Actinosphæria, four individuals were seen to become fused, as it were, into one mass.

At the end of an hour, this mass had separated into three Actinosphæria, two of the original four remaining fused into one.

This double one then became constricted, a little to one side of the middle, apparently being about to separate. In a few minutes the *Actinosphærium* began to eject, at the point of constriction, a thin protoplasmic substance containing transparent granulated globules and free granules. By a waving motion of the rays, the masses of ejected matter were broken up, and the globules set free in the water.

These globules developed from one side an extremely long ray of finely granular protoplasm, slightly elongating at the same time, thus taking an oval shape. No trace of the axial threads peculiar to the rays of adult Actinosphæria could be discovered. The average length of these globules, including the ray, was ·1422 mm.; without the ray, ·0127 mm.

The next act of the globules was the sending out another ray from a point opposite to the first. Minute vacuoles appeared and ranged themselves close to the surface of the globule. Other rays were developed at various intervals of time. The appearance of the young Actinosphæria gradually became more perfect in resemblance to the parent. The growth was very slow, the perfect form not being attained for a period varying from one to two weeks, and the size was even then small.

The external layer of vacuoles of the *Actinosphærium* from which the globules had been ejected, contained numbers of granules in active motion. In the different vacuoles the number varied from ten to about one hundred, as nearly as could be counted. They were usually congregated at one point and seemed to be trying to force a way out.

Sometimes a globular mass of protoplasm was seen to run out upon a ray, and then, instead of returning to the body as usual, drop off into the water, and develop into a perfect *Actino-*

sphærium, in the same manner as those ejected in a mass from the body.

Several free cells, having rays, were observed, upon touching a ray of the *Actinosphærium*, to glide down it in the manner usual to captured prey, and be re-absorbed into the body.

One globule of protoplasm, running out towards the point of a ray, stopped, and while motionless sent out a long ray at right-angles to that supporting the globule. Another smaller globule ran out on this secondary ray and, in its turn, sent out a third ray at right-angles to the secondary ray, but parallel to the primary ray. It has been stated that the rays of the *Actinosphærium* never branched, but the observer thought that the above phenomenon could be truly called branching, as all the protoplasm returned to the main ray, and thence to the body.

To ascertain whether any globules of protoplasm *artificially* freed from the body of the *Actinosphærium* would develop in the same manner as those above described, an *Actinosphærium* was crushed in the livebox so violently as to completely disintegrate it. The vacuoles were broken up, and the internal mass of protoplasm mixed with the water, only two or three small masses of the external vacuoles remaining intact. On removing the pressure, all the fluid protoplasm was seen to gather itself up into globules, of sizes varying from ·0507 mm. to ·253 mm.

These globules contained vacuoles, the size and number of the vacuoles varying with the size of the globules. The water became free from protoplasm, though a large number of the granules, which had been contained in the external vacuoles previous to the crushing of the *Actinosphærium*, remained swimming actively about in every direction.

The globules remained quiet for some minutes, and then began to extend pseudopodial rays. The vacuoles increased in number and arranged themselves close to the exterior of the globules, those of the largest size pushing out the thin protoplasmic covering, so as to produce a strong resemblance to the perfect *Actinosphærium*. The resemblance of each globule to the original *Actinosphærium* became more and more perfect. The few masses of the original vacuoles also protruded rays, thus conclusively showing that the rays of Actinosphæria are not necessarily dependent upon the central mass of protoplasm. The vacuole masses developed into perfect Actinosphæria much more quickly than the globules formed of the central protoplasm, an hour or two being sufficient to perfect the development. The rays of all the immature Actinosphæria were irregular and flattened and in many cases lacked the axial thread.

The Actinosphæria moved their pseudopodial rays freely in all directions, the ray being bent close to the peripheral layer of vacuoles.

From an original colony of eight individuals, a small bottleful

was manufactured in the manner above described, the time needed for development being in proportion to the size of the fragments into which the Actinosphæria were divided. The above experiments were tried on many individuals, the only difference of result, in the various instances, being in the degree of completeness with which the protoplasm separated itself from the water. It was argued from the above facts, that the power of any part of an *Actinosphærium* to develop into a perfect individual was inherent, and not dependent upon any peculiar condition of the animalcule.

Fig. 8, Pl. XLI of Leidy's Rhizopods of North America, which he doubtfully refers to the Actinosphæria, exactly resembles a medium stage in the development of the globules ejected from the body of the *Actinosphærium.*

The observer stated that the rays of *Actinosphærium*, when irritated by being compressed, would be retracted completely on all sides, and would again appear on the cessation of the disturbance.

The length of time needed for the development of the Actinosphæria, in the reproduction by natural means, was from seven to fourteen days; that needed for the development, in the reproduction by artificial means, was from one to two days.

In the latter case this length of time was needed only in cases when the crushing was carried to extremes, as, when the *Actinosphærium* was simply divided into small pieces, a few hours were all that was needed to complete the development of the fragments.

JUNE 12.

Mr. JOHN H. REDFIELD in the chair.

Twenty-three persons present.

Cutaneous Nerves in Mammals.—Dr. HARRISON ALLEN, in continuation of his remarks on the trophic value of the cutaneous nerves spoke of the distribution of the larger setæ-bearing hair-follicles in mammals as exposed after depilation. He described the oral, the mental, the supra-orbital and the proximo-carpal groups as well as those placed on the lateral aspects of the limbs. He had succeeded in tracing nerve-filaments to the follicles in all instances and held that they bore close analogies to the pteryls of the birds. In specimens in which the follicles were rudimentary he had observed failure of the nerve also, and he was thus induced to believe that a close relation existed between the setæ-bearing follicles and the nerves themselves.

The following was ordered to be printed:—

ON THE GENUS HYLIOTA.

BY GRACEANNA LEWIS.

By a letter of inquiry from Prof. G. Hartlaub, M.D., of Bremen, Germany, concerning some rare African birds of the genus *Hyliota*, attention has been drawn to the specimens now in this Academy, of which there are three, all of them being male birds.

The question at issue is whether there are two distinct species or only one; and as distinguished authorities differ on this point, it seems proper to offer to ornithologists the testimony which these specimens afford.

The genus was first characterized by Swainson, who described the species *H. flavigastra*. The bird was at first supposed to belong to India, but was subsequently found to inhabit N. E. Africa and Senegambia, and was for a long time the only known species of the genus. Our specimen agrees moderately well with Swainson's description, but is, no doubt, an immature male, the wings are brownish and are not edged with glossy purple, but instead with a dull grayish white. The two external pairs of tail feathers are edged more or less with white, as in the female. The band of white on the wing is formed largely by the middle and greater coverts, and beginning nearly at the outer edge of the wing, continues obliquely across the roots of the primaries, secondaries and tertials, meetihg on the back with the white of the rump so as to form a deep curve over the folded wings and back. The white on the wing is even more extensive than is apparent. On lifting the overlying dark plumage this color is seen to involve nearly all of the upper portion of the wing, the internal surface of which as well as the axillaries are white. The outer greater coverts are white at the base but are black glossed with green on their margins; on the external feather, the black is so reduced as to leave only a border on a white ground. The whole upper plumage of the head and back as far as the rump is of deep blue-black with glossy steel-blue reflections.

In 1851, J. and E. Verreaux described in the Rev. et Mag. de Zool., p. 308, a second species, *Muscicapa* (?) *violacea*. In the same year, H. E. Strickland brought home from the River Gaboon a specimen which he described in Jardine's Contributions to Ornithology, 1851, p. 132, under the name of *Hyliota violacea*, after having had the opportunity of consulting the manuscript of Verreaux, to which he refers. He remarks as follows: "This

bird is interesting as affording a second species of a genus of which one specimen only, the *H. flavigastra*, Swains., of Senegal, was hitherto known. It much resembles *H. flavigastra*, but differs in its broader beak, and the less extent of white on the wing. Whole upper parts black with a steel-blue gloss, of a rather more purple hue than in *flavigastra*. Three or four of the greater wing coverts next the body are white (in *flavigastra* the whole of the middle, and the basal half of the greater coverts are white). Lower parts pale cream-color.

Total length $\dot{5}$; beak to front $\ddot{5}$; to gape $\ddot{7}$; broad $\ddot{2}\frac{1}{2}$; wing $\dot{3}$; medial retrices $\dot{1}$ and $\ddot{9}$; external $\ddot{2}$; tarsus $\ddot{7}$."

Of *Hyliota violacea*, as above described, the Academy possesses two specimens. One is the identical bird on which the species was founded by Verreaux, and its characters agree with the description of that author, as well as with that of Strickland, and also with that to be found in Hartlaub's Ornithologie Westafricas, Bremen, 1857, p. 98.

The second specimen in possession of the Academy, belongs to the Du Chaillu 1st Coll., and is also from the River Gaboon. This bird is mentioned in Cassin's Catalogue, Proc. Acad. of Nat. Sciences, 1869, p. 51, but no description is given. Essentially its characters are the same as the type specimen of Verreaux.

In this species, the only white to be seen on the whole wing is on one single feather belonging to the *inner* portion of the greater coverts. There are really about five feathers belonging to the series of ornamental coverts, but they overlie each other, and are so disposed that in the closed wing only one of them is visible.

The rump in both species is covered with long, loose, silky feathers, of a white or grayish white color, from the base to near the tip, when the feather suddenly becomes dark and at the same time pennaceous in structure. The only difference between the two species appears to be in the depth of the dark margin, or its entire absence in mature specimens of *flavigastra*. In Swainson's description of the type, the rump is given as pure white, but it is not so in our specimen. The pennaceous dark border is nearly as deep as in *violacea*, so that this character cannot be relied upon as a distinction between the two species.

In his Ornithology of Angola, p. 190, Prof. Barboza du Bocage acknowledges the receipt from M. Anchieta, of one specimen of *H. violacea*. The description is that of a bird with a large amount of white on the wing. This description does not resemble the

type specimen of Verreaux, but is much more nearly like *flavigastra* Swains.

Depending on this description, R. Bowdler Sharpe gives it in his Catalogue of the Birds in the Collection of the British Museum, instead of that of Verreaux, and, in consequence, considers *H. violacea* as a doubtful species.

With the privilege of examination of the type, and of comparing this with the Du Chaillu specimen, and the descriptions of Verreaux, Strickland and Hartlaub, it seems impossible to suppose that the specimen sent by M. Anchieta to Prof. Bocage, was that of a true *violacea*, but was either *H. flavigastra*, or a form intermediate between the two.

The striking differences between the two species, are the blue-black plumage in the upper parts in *flavigastra*, and the violet-black of *violacea*; the broad bands of white on the wing of the former, and the concentrated spot on that of the latter; the darker shade of the under parts in *flavigastra*; and the white thighs of the one and the black of the other, together with the larger size of *violacea*. They also inhabit different regions, *flavigastra* belonging to the N. E. of Africa and Senegambia, while *violacea* is found southward from the Gaboon to Benguela in West Africa.

Swainson points out the general resemblance of *Hyliota* to the African todies of the genus *Platystira*, and to the Old World fly-catchers of *Muscicapa*, with a bill so much lengthened and compressed on the sides that at first sight it might be mistaken for a *Sylvia*.

It also agrees with *Muscicapa* and *Cryptolopha* in having the base of the bill broad and depressed as far as the nostrils, and then compressed to the extremity, the bill being so much lengthened in *Hyliota* that it becomes the tenuirostral form of the group to which it belongs.

The glossy blue-black plumage, white wings and buff throat are in unison with related fly-catchers. By the rump feathers Swainson detects an analogy with the caterpillar-catchers of the Ceblepyrinæ.

In *Hyliota* the sexes differ remarkably in color, as they do also in *Platystira*, such difference not being the rule in the family of the *Muscicapidæ*. *Hyliota* agrees with the fly-catchers in general by its small and weak feet and its syndactyle toes, the outer being connected with the middle as far as the first joints. The wings and tail are those of *Muscicapa*, in which group *Hyliota* is placed by ornithologists.

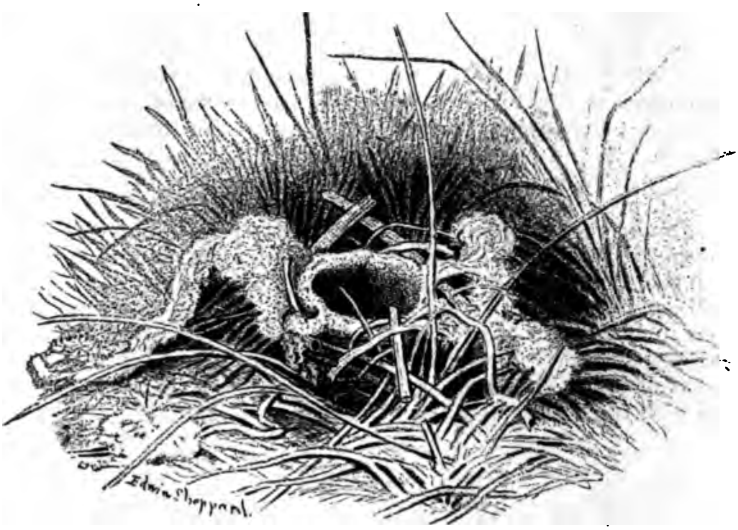
JUNE 19.

The Rev. H. C. McCOOK, Vice-President, in the chair.

Twenty-nine persons present.

The death of J. B. Gassies, a correspondent, was announced.

Note on the Intelligence of the American Turret Spider.—The Rev. Dr. H. C. McCOOK exhibited nests of *Tarentula arenicola* Scudder, a species of ground-spider, of the family Lycosidæ, popularly known as the Turret Spider. These nests, in natural site, are surmounted by structures which quite closely resemble miniature old-fashioned chimneys, composed of mud and crossed



Nest of Turret Spider, lined with cotton.

sticks, as seen in the log cabins of pioneer settlers. From half an inch to one inch of the tube projects above ground, while it extends straight downwards twelve or more inches into the earth. The projecting portion or turret is in the form of a pentagon, more or less regular, and is built up of bits of grass, stalks of straw, small twigs, etc., laid across each other at the corners. The upper and projecting parts have a thin lining of silk. Taking its position just inside the watch-tower, the spider leaps out and captures such insects as may come in its way. The speaker has found nests of the species at the base of the Allegheny Mountains near Altoona, and in New Jersey on the seashore. In the latter location the animal had availed itself of the building material at hand, by

forming the foundation of its watch-tower of little quartz pebbles, sometimes producing a structure of considerable beauty. In this sandy site, the tube is preserved intact by a delicate secretion of silk, to which the particles of sand adhere. This secretion scarcely presents the character of a web-lining, but has sufficient consistency to hold aloft a frail cylinder of sand and silk, when the sand is carefully scooped away from the site of the nest.

A nest recently obtained from Vineland, N. J., furnished an interesting illustration of the power of these araneads to intelligently adapt themselves to varying surroundings and to take advantage of circumstances with which they certainly could not have been previously familiar. In order to preserve the nest, with a view to study the life-history of its occupant, the sod containing the tube had been carefully dug up and the upper and lower openings plugged with cotton. Upon the arrival of the nest in Philadelphia, the plug guarding the entrance had been removed, but the other had been forgotten and allowed to remain. The spider, which still inhabited the tube, immediately began removing the cotton at the lower portion, and cast some of it out. But guided apparently by its sense of touch to the knowledge that the soft fibres of the cotton would be an excellent material with which to line its tube, she speedily began putting it to that use, and had soon spread a soft, smooth layer over the inner surface and around the opening. The nest, in this condition, was exhibited and showed the interior to be padded for about four inches from the summit of the tower. Dr. McCook pointed out the very manifest inference that the spider must for the first time have come in contact with such a material as cotton, and had immediately utilized its new experience by substituting the soft fibre for the ordinary silken lining; or, rather, adding it thereto. This nest with the cotton wadding is figured on p. 131.

JUNE 26.

Dr. W. S. W. RUSCHENBERGER, in the chair.

Twenty-three persons present.

The Fishes of the Batsto River, N. J.—Prof. COPE gave an account of the results of fishing in the confined waters of a broken dam on the Batsto River, New Jersey. The species obtained were the following. Percidæ: *Pœcilichthys erochrous* Cope; *Enneacanthus simulans* Cope; *Mesogonistius chætodon* Baird; Aphododeridæ: *Aphododerus sayanus* Gill.; Umbridæ: *Umbra limi* Kirtl.; Esocidæ: *Esox umbrosus* Kirt.; *Esox reticulatus* Les.; Cyprinidæ: *Cliola chalybæa* Cope; Catostomidæ: *Erimyzon sucetta* Lac.; Siluridæ: AMIURUS PROSTHISTIUS Cope, sp. nov.; Anguillidæ: *Anguilla rostrata* Les. Prof. Cope remarked that these fishes represent the fish fauna of the Carolinian district of

the Nearctic realm, only three of the above, *Esox reticulatus*, *Erimyzon sucetta* and *Anguilla rostrata*, extending into the Alleghanian district. Of the remaining eight species, four are restricted to New Jersey, and in the case of two of them, *Pœcilichthys erochrous* and *Mesogonistius chætodon*, the corresponding parts of Delaware; the other two species being *Cliola chalybæa* and *Amiurus prosthistius*. *Pœcilichthys erochrous* is the only Etheostomine perch which inhabits muddy waters, though it is not confined to such bottom, living as well in the gravelly but dark brown-stained streams of the New Jersey pines. The *Amiurus* is new to science, which is quite unexpected in the case of so large a fish. Its characters are as follows:—

Caudal fin rounded when expanded, not straight or slightly concave, the marginal rays being shortened. Anal fin long, one specimen with 27 rays, two with 25, and one with 24 rays. Anterior dorsal fin a good deal nearer the end of the muzzle than to the adipose fin. Length of head 2·66 times in length without caudal fin; depth at first anal ray 4·25 times in same. Greatest width of head just equal to depth of body at first anal ray. Eyes small, the space between them five times their long diameter. Pectoral spines a little larger than dorsal spines, with posterior points only, which are stronger than those of the dorsal. Maxillary barbel to near the middle of pectoral spine; humeral process little roughened, extending a little beyond middle of spine. Radii D. I. 6; C. + 18 +; V. 8; P. I. 8. Color generally black; the under surface of the head silvery white, fading on the belly to dull white and posteriorly pink, as far as base of anal fin. Fins black, pectorals and ventrals pale at base. Total length m. 0·208; from end of muzzle to base of dorsal spine, ·042; to posterior base of adipose fin ·149; to base of caudal fin (end of hæmapophysis) ·170. Depth at first anal ray ·039. Total length of a larger specimen ·233.

When first seen the specimens of this species were supposed to be unusually dark-colored examples of the common *Amiurus nebulosus*. A critical examination soon showed that they differ in the important characters of the considerably more anterior position of the dorsal fin, 4 to 7 more anal radii, and more rounded outline of the caudal fin. He had compared it with the *A. nebulosus* from Lake George, N. Y., and from the Hudson and Delaware Rivers. In fact its characters ally it to the western *A. natalis*, from which it differs by its more slender form and more rounded caudal fin.

The following was ordered to be printed:—

ON THE FISHES OF THE RECENT AND PLIOCENE LAKES OF THE WESTERN PART OF THE GREAT BASIN, AND OF THE IDAHO PLIOCENE LAKE.

BY E. D. COPE.

PRELIMINARY OBSERVATIONS.

The numerous lakes of the northwestern part of the Great Basin present many points of interest to the geologist and biologist. The region which they occupy is one of comparatively recent geological disturbance, so that their topographical features may be regarded as of relatively modern origin. Their former greater extent and intercommunication in groups has been clearly pointed out by the geologists of the U. S. Survey of the Fortieth Parallel; and the species of fishes found in the pliocene and post-pliocene deposits of the adjacent regions have been shown by myself[1] to be nearly allied to those now living in the present lakes.

The geologists of the fortieth parallel have shown that a large part of the present Territory of Utah was, during late tertiary time, occupied by a large body of water, of which Salt Lake, Utah Lake and Sevier Lake are the present representatives. To this ancient sea they have given the name of Lake Bonneville. They have also shown that the existing lakes of the western region of Nevada were formerly united into an extensive body of water, to which they have given the name of Lake Lahontan. It included the existing Walker's, Carson, Humboldt, Pyramid and Winnemucca Lakes. It is exceedingly probable that it will be shown that a third lake existed in Oregon, north of the supposed northern boundary of Lake Lahontan, which is now represented by the Warner Lakes, Abert's Lake, Summer Lake and Silver Lake, and probably by Harney's and Malheur Lakes on the eastern side of the Oregon desert. As will be shown later, the larger species of fishes found in such of these lakes as contain them, are identical, and different from those of the lakes of the Bonneville series. One species, the *Catostomus tahoensis*, is common to this area and that of the true Lahontan Lakes (Tahoe and Pyramid), and this Oregon lake may have been continuous with that of Nevada, at a point some distance east of the mountains. Goose Lake, the Klamath Lakes, and doubtless Rhett and Clear Lakes,

[1] Proceedings American Philosophical Society, Nov. 1870 and Dec. 1877.

form another series, characterized by several points of resemblance in their fish faunæ. Whether they were connected, forming a single body, at an earlier geological period, is not yet known. Some of them are connected by rivers and creeks at the present time, and the Klamath River discharges the contents of the lakes of the same name into the Pacific Ocean.

Still another late tertiary lake existed in Eastern Oregon and Western and Southern Idaho. No body of water represents it at the present time, and the remains of fishes found in its sediments belong to species different from those of the Oregon basin, both recent and extinct. It is to be supposed that this lake was separate from all of the others, and of earlier age, although one of the pliocene series. It may be called Lake Idaho, and its sediment, the Idaho formation. A list of its species will be given after the consideration of the characters of the faunæ of the Lahontan and Klamath Lakes.

The cause of the desiccation of the Great Basin and other interior regions of our continent, has not been satisfactorily explained. It is usually ascribed to the intervention of the Sierra Nevada and Rocky Mountain ranges, which precipitate the clouds from the Pacific Ocean, and thus deprive the regions eastward of rain. This would at first appear to be a sufficient explanation, but the facts of geological history contradict it. The existence of extensive lakes throughout the now dry region, in pliocene and postpliocene time, has been already referred to. But the Sierra Nevada was no less elevated then than now. Furthermore, great lakes or seas occupied the centre of the continent during miocene time, when the ranges were still higher. Vast forests of vegetation, and a rich population of animal life, point to a humid climate during the entire period that has elapsed since the great elevation of the Rocky Mountains in the beginning of the eocene epoch, to within comparatively recent times. Yet the mountains have been steadily diminishing by erosion throughout that period.

Of course the comparatively low elevation of the Great Basin would accelerate its desiccation, other conditions being equal. Mr. J. D. Clayton,[1] of Salt Lake City, discovered immense faults along the western slope of the Wasatch Mountains, and proposed the hypothesis that the entire area of the Great Basin had de-

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[1] Published, I believe, in a number of the Salt Lake *Herald*, which I cannot at present lay my hands on.

scended several thousand feet during tertiary times. Mr. C. King[1] states that the fault along the eastern edge of the basin amounts to 30,000 feet, and that along the western border, from 3000 to 10,000 feet. The elevation of Pyramid Lake above the sea level is now, according to King,[2] 3890 feet. That of the Great Salt Lake is, according to Emmons, 4200 feet.[3] The depression, according to King, took place on the eastern side during early eocene times, and may have been nearly simultaneous on the western border. As a consequence of it, the Manti and Amyzon beds were deposited, representing the eocene period west of the Wasatch Mountains.

I. The Lahontan and Klamath Lakes.

The lakes of the Great Basin in Nevada and Oregon diminish in alkalinity as we approach the Sierra Nevada Mountains. While desiccation has concentrated the salts in all of them, those near the mountains have been maintained in a more or less fresh condition by the constant influx of the pure water of the mountain streams. The lakes most remote from the mountains are not habitable by fishes, their only animal population being crustacea and the larvæ of insects. Such are Summer and Christmas Lakes of Oregon; and the Malheur and Harney Lakes are said to have the same character. That of Pyramid Lake, although receiving the fresh waters of the Truckee River, is too alkaline to be potable. The following analysis is given in Mr. King's II Vol. of the Survey of the 40th Parallel (p. 824), as made by Prof. O. D. Allen, of Yale College:

Magnesia,	0·1292
Sodium,	0·8999
Soda,	0·4234
Chlorine,	1·3870
Sulphuric Acid,	0·1400
Carbonate of Lime,	0·0178
Carbonic Acid,	0·2392
	3·2365

in 1000 parts of the water.

[1] Survey of the 40th Parallel, i, p. 744.

[2] Loc. cit., iii, p. 822.

[3] Loc. cit., ii, p. 466.

The water of the Upper Klamath Lake is slightly alkaline to the taste, and less so than that of Pyramid Lake. The waters of Goose and Silver Lakes are similar to it, while that of Warner's Lake is rather more alkaline. All of these lakes abound in fishes. Summer Lake, Christmas Lake, and others, are intensely alkaline to the taste.

The locality which has furnished the greatest number of fossil remains of the pliocene or postpliocene ages, is known as Fossil Lake. It is twenty miles east of Silver Lake, in the western part of the Oregon Desert. It is a shallow depression of perhaps a hundred acres in extent, where drinkable water may be obtained by digging. The soil is a mixture of sand and clay, which supports a more or less luxuriant growth of Artemisia. Bones of extinct and recent species of vertebrata, thoroughly fossilized, mixed with worked flints,[1] and shells of *Carinifex newberryi* bleached snow-white, lie in profusion in this light material. Within a short distance of this locality the soil becomes sandy, and a few miles northeastward the surface of the country consists of sand-dunes, which rise to a height of one hundred feet. The sand is constantly moving to the northeast under the influence of the prevailing southwest wind, creeping up the long southwest slope of the dunes, and falling in a fine shower over the apex of the vertical northeast face. This tract is perhaps twenty miles in diameter.[2] A smaller tract of a similar character lies at the northern end of Summer Lake, where the sand is piled up against the basaltic hills that bound its valley on the east. I have given lists of the vertebrate fossils of this region, as cited in the accompanying foot-notes.

As described by Emmons,[3] Pyramid Lake is thirty miles long, by twelve wide. It is surrounded by mountains of eruptive granite, trachyte and basalt. According to King, the level of this lake rose, between 1867 and 1871, nine feet, while that of the connected lake, Winnemucca, rose twenty-two feet. This lake is exceedingly rich in life, as will be pointed out by and by. Messrs. Jordan and Bean[4] have catalogued several species of fishes as

[1] See *American Naturalist*, 1878, p. 125.

[2] See Bulletin of the U. S. Geol. Survey of the Territories, F. V. Hayden, iv, p. 389; v, p. 48.

[3] Survey of the 40th Parallel, i, p. 506.

[4] Rept. of the Chief of Engineers, U. S. A. Expl. and Surv. W. of 100th Mer., G. M. Wheeler, 8vo, 1878, p. 187.

found in it, and I enumerate several additional ones in the present article.

The Mud Lakes in the neighborhood south of Fort Bidwell lie in a monoclinal valley of moderately inclined beds of a plutonic outflow. The strata dip towards the Sierra Nevadas, westwards. A high divide on the north separates these lake basins from that of the Warner Lakes. As already remarked, it is possible that they may have been connected by water, which occupied lower lands to the eastward, but this point remains as yet unsolved.

The four Warner Lakes occupy a long valley, which trends north and south. They are connected by a stream which flows through a succession of swamps of *Typha latifolia*. They abound in fishes and fishing-birds. The valley is apparently a fractured anticlinal, the strata dipping away from the lake on both the east and the west sides. The rocks are a dark-colored basalt. At the first and second lakes the western bluff is the higher, reaching, to judge by the eye, nearly a thousand feet elevation at the lower part of the third lake. At the northern part of the latter, at Wilson's Ranch, the eastern bluff is the higher, reaching the grand proportions of two thousand feet, estimated measurement.

Summer Lake is eighteen miles long and six or seven miles wide. The hills and bluffs of the western side probably reach a thousand feet in elevation. Those of the eastern side are much less elevated, and are separated from the water by a wide slope of sand and alkaline earth and mud. The western range is basaltic. At one point where the escarpment is especially steep, the brown basalt is overlaid by a deposit of white pumice or siliceous dust, which is worn into a picturesque sculpture by the weather.

I did not get a near view of Abert Lake, but it lies between high basaltic bluffs, of which the eastern is the more elevated, rising to a great height above the water. It is supplied with water by the Chewaucan River, which is a large creek with a fine flow of pure water. It abounds in fishes, especially the trout, *Salmo purpuratus*.

Silver Lake also lies in a valley with eastern and western walls of basalt. The strata of which the walls are composed, dip away from each other here, as at Warner's Lake, producing the impression that the lake occupies a fracture in an anticlinal. A range of hills, terminating at its eastern extremity in a bluff, extends along

the north side of the lake. The rock of which it is composed differs from those of the principal ranges, in being a finely bedded volcanic conglomerate mud. The same material forms bluffs forty-five miles eastward in the desert. During the season of 1882 the waters of Silver Lake rose higher than had been previously known. It is probable that these lakes are rising, as is the case with Pyramid Lake. A comparatively small elevation would connect the waters of Silver Lake with Summer Lake, eighteen miles distant, and those of Summer Lake with the Chewaucan River, seven miles distant. This would convert the Chewaucan Swamp into a lake, and connect the Abert Lake with the series.

Goose Lake is thirty miles in length and about ten miles in width. It is bounded on the east and west by eruptive mountains of no great elevation near the lake, but which rise gradually to a considerable height, especially to the eastward. To the north and south the valley of the lake continues for several miles. It is cut off to the north by the watershed of the Chewaucan, and to the south by that of Pitt River. The scenery of its banks is tame as compared with that of some of the other lakes, but presents nevertheless many elements of beauty. It is shallow for a long distance from its northern and eastern shores. It abounds in fishes and water-birds. I fished for a day with hook and line without success, but procured a good collection of fishes by another method. I found numerous specimens both fresh and dry, which had been dropped by fishing-birds on or near the shore.

The great or Upper Klamath Lake is thirty-two miles long, and of irregular width, and is said to be twelve miles across its widest part. Its western shore is the base of the Cascade Mountains, and its eastern shore is bordered by a low range of eruptive hills. Both shores are wooded; and the scenery, though it lacks the rugged grandeur of that of Warner's and Abert's Lakes, is highly picturesque. The symmetrical proportions of Mount Pitt are ever visible on its eastern shore, while the more central peaks of the Cascades are in view from its northern extremity. It is fed by several streams, the most important of which is the Williamson's River, which enters it from the east. This has a considerable flow of water. The Link River, which connects the Upper and Lower Klamath Lakes with the Klamath River, is a wide and rapid stream containing much water.

The Upper Klamath Lake is more prolific in animal life than any body of water known to me. The proportion of alkali which it contains appears most favorable to the development of life. Its waters are full of vegetable impurities, living and dead, and mollusca and crustacea abound everywhere. These sustain a great population of fishes, which, though not numerous in species, is so in individuals. Swarms of fishing-birds employ themselves in catching them living from the lake. The most abundant mollusca are the *Planorbis* (*Carinifex*) *newberryi* Lea, and a *Lymnæa*. A probably hydroid polyp is found attached to the bark of submerged trees in large numbers. Its creeping yellowish stems are imbedded in sarcode, forming a continuous mass. Each zoöid is of an elongate oval form, sessile, and with six rays of equal size, each one-half as long as the body. These zoöids are translucent, but with two oval bodies in the lower half of the body-cavity, of a yellow color. The masses are as large as the fist. The length of each zoöid is one millimetre. They did not extend themselves beyond this length, neither did the rays elongate to beyond half the same, so long as I observed them. They retracted themselves on being irritated. They do not possess any fringes like the arms of the Polyzoa. As the possession of a cœnœcium distinguishes this genus from all the fresh-water hydroids, I propose to characterize this remarkable form as the type of a new genus, with the name of *Rhizohydra*, and the species, by the name of *flavitincta*.[1]

The following mollusca which I obtained were identified by Mr. Tryon, to whom my acknowledgments are due:—

Ancylus newberryi Lea.
Limnæa stagnalis Lea.
Physa gyrina Say.
Pompholyx effusa Lea.
Planorbis corpulentus Say.
Carinifex newberryi Lea.
Anodonta wahlamatensis Lea.

In my explorations of these lakes, I was greatly aided by Col. Whipple, in command at Fort Klamath, and Col. Barnard, in command at Fort Bidwell, and Dr. George Kober, surgeon at the

[1] My attempts to preserve some of the masses of this animal in alcohol were not successful.

latter post. To these gentlemen I wish to express my thanks. My especial thanks are also due to General W. T. Sherman, commander-in-chief of the army, from whom I have received many favors, on this and other occasions.

Synopsis of the Fishes.

ISOSPONDYLI.

Salmo purpuratus Pallas.

Pyramid Lake; Chewaucan River; Silver Creek (tributary of Silver Lake); Klamath Lake, and Williamson's River.

As Jordan remarks, this fish varies as to its color-shades, and is hence imagined by fishermen to include several species. A specimen from Link River (the part of Klamath River connecting the Klamath Lakes) is nearly silver-white. Specimens from Williamson's River are of darker color. I examined a large number of individuals from that stream, and found the following variations in some of them. One specimen Br. XI; Anal 10$\frac{1}{1}$; one, Br. XII, A. 9$\frac{1}{1}$; six, Br. XII, A. 10$\frac{1}{1}$; three, Br. XIII, A. 10$\frac{1}{1}$; one, Br. XIII, A. 11$\frac{1}{1}$; one, Br. XIII, A. 12$\frac{1}{1}$.

An important food fish, sometimes reaching ten pounds in Klamath Lake.

Salvelinus malma Walb.

Seven-mile Creek, which enters Lake Klamath from the northwest.

PLECTOSPONDYLI.

APOCOPE Cope.

Apocope ventricosa Cope. Jordan, l. c., p. 211.

Abundant in the small streams near Fort Bidwell, N. E. California.

Apocope vulnerata Cope. Jordan, l. c., p. 210.

Abundant in streams near Fort Bidwell, and in those tributary to Warner's Lake and Abert's Lake.

AGOSIA Gird.

This genus is stated by Jordan to agree with *Apocope*, excepting in the possession of a complete lateral line.

Agosia novemradiata Cope, sp. nov.

Scales 11–60–11; radii, dorsal I. 9; anal I. 7. The head is rather elongate, especially the muzzle, which projects a little beyond the mouth. Eye 4·5 times in length of head; 1·5 times in

length of muzzle, and in interorbital width. Head four times in length without caudal fin; depth at ventral fin, five times in the same. Dorsal fin originating behind line of last ventral ray; radii always I. 9. Caudal peduncle rather deep.

Measurements.	M.
Total length (with caudal fin),	·107
Length to edge of operculum,	·010
Length to first ventral ray (outside),	·044
Length to first dorsal ray (outside),	·047
Length to first anal ray (outside),	·060
Length to base of caudal fin,	·085
Depth at occipital region,	·013
Depth at first dorsal ray,	·018
Depth at first anal ray,	·016
Depth of caudal peduncle,	·009

Color silvery, dusted with smoky, to below the lateral line, and marked on the sides and back with several rows of dusky spots. Bases of inferior fins and upper lip red.

This species differs from the species of *Apocope*, which it generally resembles, in having a perfect lateral line. It agrees with the *A. henshavi* in having nine dorsal rays, but has a longer muzzle and larger scales. The latter has the following scale formula, 16–67–12. It is possible that some of the specimens referred by Jordan to the *A. henshavi* belong here. Abundant in Weber River at Echo, Utah.

CLIOLA Gird.

Hybopsis "Agass." Cope and others.

Cliola angustarca Cope. Proceeds. Amer. Philos. Society, 1877, p. 230.

Well distinguished from the allied fossil species by its narrower pharyngeal bones, and its teeth 4–4. Fossil Lake, Oregon.

MYLOLEUCUS Cope.

Annual Report U. S. Geol. Survey Terrs., 1871, p. 475. Jordan, Synopsis Fishes North America, 1883, p. 887.

This genus differs from *Leucus* Heck. in its dental formula, 5–4 instead of 5–5. It is characteristic of the streams and lakes of the Great Basin, and of those waters of Oregon and California which lie nearest to them. Most of the lakes of southwestern Oregon contain them, and their variations are such as to render their

specific characters somewhat difficult to unravel. Teeth of species of this genus occur in the pliocene lake deposits of the Great Basin.

Myloleucus gibbarcus Cope. *Alburnops gibbarcus* Cope, Proceeds. Amer. Philos. Society, 1877, p. 230. *Anchybopsis breviarcus* Cope, l. c., p. 229.

The presence of four teeth on the right pharyngeal bone of specimens referred to *Alburnops*, as above, is not established; and the other characters point to the specific identity of the individuals included under the two names cited. It was abundant in a fossil state at Fossil Lake, Oregon, whence I have obtained about twenty pharyngeal bones of both sides. First discovered by Chas. M. Sternberg.

The recent species may be distinguished as follows:—

Scales 11-12—51-5—6-7; anal rays I. 8; head 3·5; depth 3·5 to 4 times in length. *M. formosus.*

Scales 10—47-50—5; anal rays I. 8; head 3·5; depth 4 times in length. *M. parovanus.*

Scales 9–46–4; anal rays I. 9; head 3·75; depth 4·5 times in length. *M. thallassinus.*

Myloleucus formosus Girard. Jordan, Synopsis Fishes N.A., p. xxi. *Leucus formosus* Jordan, Report Capt. G. M. Wheeler, Expl. W. 100th Mer., 8vo, 1878, p. 193.

Specimens of this fish from Silver Lake represent a form of the species allied to the *M. obesus*, in the greater depth of the body than those found in the Chewaucan River and the Warner Lakes. In the first named, the depth enters the length 3·5 times; in the last two, four times. The Silver Lake specimens diverge from the types in having the scales a little larger. They are thus counted in the three sets of specimens:—

Silver Lake 11—51-3—8; Chewaucan 11–55-7; Warner Lake 12—54-5—7. The largest specimen is from Warner's Lake and measures 8½ inches in length.

Myloleucus parovanus Cope. Zoology Wheeler's Expl. Surv. W. 100th Mer., p. 669.

This species was originally described by me from the Beaver River of Utah. It now appears that is the most abundant cyprinoid of Goose and Klamath Lakes. It reaches a length of 10 to 12 inches, and forms a large part of the food of the great flocks of various species of fishing-birds which live at those lakes. Its specific characters are constant in a large number of individuals. Prof. Jordan identified this species with the *M. bicolor*

of Girard, but he gives the scale formula of that species as 8–50–5, and the anal rays as 7—characters quite inconsistent with the *M. parovanus*.

Myloleucus thalassinus sp. nov.

This species rests on a single specimen which I obtained at Goose Lake, Oregon. It is a more slender fish than the *M. parovanus*, and its color when fresh is light, translucent green, quite different from the more or less heavy olivaceous color of the latter. Its proportions are expressed in the key above given, as well as the smaller number of longitudinal rows of scales, and the additional ray of the anal fin.

Measurements.	M.
Total length (with caudal fin),	·143
Length to edge of opercle,	·031
Length to base of dorsal on lateral line,	·059
Length to base of ventral on lateral line,	·061
Length to base of anal on lateral line,	·0805
Length to base of caudal on lateral line,	·114
Depth at first dorsal ray,	·026
Depth at first anal ray,	·022
Depth of caudal peduncle,	·014
Width of interorbital region,	·010
Width of orbit,	·007

LEUCUS Heckel.

Fische Syriens, 1843, p. 48. *Anchybopsis* Cope, Proceed. Amer. Philos. Society, 1870, p. 543.

I found recent species of this genus in Pyramid Lake, Nevada, only. Some extinct species occur in the pliocene beds of Oregon and Idaho.[1] The two species from Pyramid Lake differ as follows:

Scales 13-14—56-9—7-8; anal rays I. 8; head 3·66 in length; depth 4 (3·75); eye in head 5 times. *L. olivaceus.*

Scales 14-15—63-6—8; anal rays I. 8; head 4 times in length; depth 4·5 times; eye 3·5 in head. *L. dimidiatus.*

[1] *Leucus latus; Anchybopsis latus* Cope, Proceeds. Amer. Philos. Soc., l. c., Idaho; size large. *Leucus altarcus; Anchybopsis altarcus* Cope, loc. cit., 1877, p. 229. From Oregon; small.

Leucus olivaceus sp. nov.

The largest cyprinoid of the Pyramid Lake, and very abundant. The shape is a regularly compressed fusiform. The head narrows to the muzzle, and the mouth opens obliquely forwards and upwards. The end of the maxillary bone, when the mouth is closed, is concealed in a sheath, and extends a little beyond the anterior margin of the eye. The latter enters the length of the muzzle (without the chin) 1·33 times; and the interorbital space 1·60 times. Middle of front a flat longitudinal surface, bounded on each side by an angle, from which the surface slopes to the superciliary border. In the *Myloleucus parovanus*, a fish of similar size, the frontal is flat roof-shaped, there being a median longitudinal angle. In specimens from Klamath Lake, however, the lateral angles are more distinct than in those from Goose Lake. This fish is everywhere a dusky olive, except on the belly, which is silvery. No lateral band. Fins dusky.

Measurements.	M.
Total length, with caudal fin,	·283
Length to edge of opercle,	·064
Length to base of dorsal, on lateral line,	·122
Length to base of ventral, on lateral line,	·131
Length to base of anal, on lateral line,	·173
Length to base of caudal, on lateral line,	·235
Depth at first dorsal ray,	·060
Depth at first anal ray,	·043
Depth at caudal peduncle,	·027
Width of interorbital region,	·020
Width of orbit,	·0126

This and the smaller *L. dimidiatus* swim in schools in the lake, and may be seen from the elevated road along the rocky shores, rippling the surface like a gust of wind. At this signal, the pelicans, gulls and terns quickly congregate, and are soon actively employed in fishing.

Leucus dimidiatus Cope, sp. nov.

This very abundant fish is much smaller than the adult *L. olivaceus*, and has a more slender form, smaller scales, and a different coloration. The eye nearly equals the interorbital width

and a little exceeds the length of the muzzle. The mouth slopes upwards, and the extremity of the maxillary bone reaches to the anterior edge of the orbit. The ventral fin originates behind the point below the first dorsal ray by the width of a ray. The fins are all rather small, except the caudal. The sides and belly are a pure silver-white up to the eighth row of scales below the dorsal fin. Above that line the sides and back are a light brown, becoming lead-colored along the border of the white. In some specimens this lead-color forms an obscure band.

Measurements.	M.
Total length with caudal fin, ...	·104
Length to edge of opercle, ...	·021
Length to first dorsal ray on lateral line, . .	·042
Length to first ventral ray on lateral line, . .	·043
Length to first anal ray on lateral line, . . .	·060
Length to caudal fin on lateral line, . . .	·084
Depth at first dorsal ray, ...	·019
Depth at first anal ray, ...	·0148
Depth at first caudal peduncle, ...	.009
Width of interorbital space, ...	·007
Width of orbit, ...	·006

This species exists in immense numbers in Pyramid Lake, where it doubtless furnishes much food for the trout, *Salmo purpuratus*.

Leucus altarcus Cope. *Anchybopsis altarcus* Cope, Proceeds. Amer. Philosoph. Soc., 1877, p. 229.

Extinct; from Fossil Lake, Oregon, only. Represented by pharyngeal bones and teeth.

SIPHATELES Cope.

Gen. Nov. Char.—Pharyngeal teeth 5–5, with well developed grinding surfaces. Ventral fins beneath the anterior part of the dorsal. Lateral line very imperfectly developed.

This genus is *Leucus*, with undeveloped lateral line. The only species does not resemble any of the others here described.

Siphateles vittatus sp. nov.

Scales 11–55–5; radii D. I. 8; A. I. 8. Head 4 times in length without caudal fin; depth of body 4·5 times in the same. Eye one-third of length of head, and a very little less than interorbital

width. Mouth opening obliquely upwards, the maxillary not quite reaching the anterior edge of the eye.

Measurements.	M.
Total length with caudal fin,	·077
Length to edge of operculum,	·016
Length to line of dorsal fin on lateral line,	·0323
Length to line of ventral fin on lateral line,	·0328
Length to line of anal fin on lateral line,	·045
Length to base of caudal on lateral line,	·061
Depth at first dorsal ray,	.0133
Depth at first anal ray,	·0105
Depth of caudal peduncle,	·0068
Diameter of interorbital space,	·045
Diameter of eye,	·0445

Belly and sides silvery; a straight lead-colored lateral band; above this, pale reddish (in spirits). The leaden band is interrupted at the base of the caudal fin by a vertical band of straw-yellow, which has a dark posterior edge.

In the species of *Leucus* from the same locality (Pyramid Lake), there are 23 or 24 longitudinal rows of scales; in this one there are only 17.

SQUALIUS Bonap.

Jordan, Synopsis Fishes N. America, p. 230.

The species of this genus, as defined by Jordan, that I have observed in the Oregon Lakes, are two, which differ as follows:

Scales 13–63–7; dorsal rays I. 9; head 3·75 to 4 times in length; depth in do. 4 times; eyes in head 4·25 times; teeth 2·5–5·2. *S. cœruleus.*

Scales 12–60–5; dorsal rays I. 8; head 4 times in length; depth in do. 4·25 times; eye in head 3 times; teeth 1·4–5·1. *S. galtiæ.*

Squalius cœruleus Girard. Jordan, l. c., p. 241.

Abundant in Klamath Lake. The specimens differ among themselves somewhat; thus, the depth enters the length 3·60 times in some; 4 times in others. The dorsal fin originates above the ventral in some; a little behind in others. The teeth all have the grinding surface distinct, and the dorsal fin always has I. 9 rays. Length of the longest specimen, 5⅛ inches.

Squalius galtiæ sp. nov.

This species belongs to the group *Clinostomus*, where the dorsal fin originates a little behind the line of the front of the ventrals, and the teeth have no grinding surface. The lateral line is, on the other hand, but little decurved, and there are but eight anal rays (in one specimen nine). The muzzle is short and the mouth oblique, without prominent chin, and with the extremity of the maxillary bone extending a little beyond the line of the anterior rim of the orbit. The interorbital region is gently and regularly convex, and is as wide as the diameter of the orbit.

The color is olive above, as far laterally as a plumbeous band which extends from the superior angle of the operculum to the middle of the base of the caudal fin. Below this line, the sides and belly are silver, except a broad band of crimson, which extends from the branchial fissure, to the line of the first anal ray. Side of head with a dusky band. This is the only species I have seen in this region which displays brilliant colors.

Measurements.	M.
Total length with caudal fin,	·067
Length to edge of opercle,	·014
Length to first dorsal ray on side,	·0298
Length to first ventral ray on side,	·0282
Length to first anal ray on side,	·0385
Length to base of caudal fin,	·056
Depth at first dorsal ray,	·014
Depth at first anal ray,	·0103
Depth of caudal peduncle,	·006
Interorbital width,	·0043

This pretty species is quite abundant in Pyramid Lake.

CHASMISTES Jordan.

This curious genus is confined to the lakes of the Great Basin. One species, the *C. liorus* J. and G., is very abundant in the Utah Lake, while the others occur on the western side of the same zoölogical area. Two of them I discovered in Lake Klamath in 1879, and I now add a fourth from Pyramid Lake. These fishes are the largest that inhabit the waters of the Great Basin. They are essentially Catostomi in which the fleshy lips are wanting, the mouth having the characters of the majority of the Cyprinidæ.

Chasmistes cujus sp. nov.

I procured but one specimen of this fish from Pyramid Lake, where it is difficult to obtain. The size is large; the specimen I procured measured eighteen inches in length. The head is wide and flat, the width of the interorbital space being more than half the length. The upper lip is very thin; the lower lip is represented by folds on each side, which do not connect round the symphysis. Scales 13–65–11. Dorsal rays 12; anal I. 8. The eye enters the length of the head 8·5 times, and the interorbital width 4·5 times. The swim-bladder has but two cells. The colors are pale olive.

The pharyngeal teeth of this species are much like those of the *C. liorus* in their triangular section; they are, nevertheless, of delicate construction. The head of this species is relatively larger and wider than in any of the others, which gives it a heavy and clumsy appearance.

This fish is said by the fishermen to inhabit the deepest water, and to be seen in numbers only at the time of breeding. Its habits in this respect agree with what is said of the *C. luxatus* of the Klamath Lake. The Indian name of the *Chasmistes cujus* is "Couia."

Chasmistes brevirostris Cope. American Naturalist, 1879, p. 785. Jordan, Fishes N. Amer., p. 132, 1883.

This fish does not exceed 14 to 16 inches in length, and has a differently formed head and muzzle from the *C. luxatus*. They are shorter, especially the muzzle, and the latter is without the hump produced by the protuberant premaxillary spines. Parietal fontanelle small. The lower lip-fold is only present at the sides of the mandible. Both lips are smooth. Eye round, its diameter entering the length of the head six and two-thirds times, of which three times enters the muzzle. Interorbital region flat, its width entering the length of the head two and one-eighth times. Body nearly cylindric. Scales 12–74–11; radii D. 11, A. 9. Color dusky above, silvery below; fins colorless. This fish is abundant in Klamath Lake, but I was informed by a Klamath chief, that it does not ascend Williamson's River in spring with the *C. luxatus* and *Catostomus labiatus*. Klamath name, "Xoöptu."

Chasmistes luxatus Cope, American Naturalist, 1879, p. 785. Jordan, l. c., p. 132.

Form elongate; head long, flat above, and with a large fontanelle. Mouth terminal, the spines of the premaxillary bones projecting so as to form a hump on the top of the snout. Lower lip a very

thin dermal fold, extending entirely around the chin. Both upper and lower lips delicately tubercular. Eye oval, the axis longitudinal, and contained seven times in the length of the head, of which three and a-half times are contained in the muzzle. Interorbital region flat, one-third as wide as the head is long. Scales 12–80–9; radii D. 11, A. 9. Color clouded above with black punctulations; below paler, with red shades in some specimens; fins uncolored. It attains a length of nearly three feet. It ascends the streams tributary to Lake Klamath in thousands in the spring, and is taken and dried in great numbers by the Klamath and Modoc Indians. The former call it "Tswam."

The character of the lips, the oval eye, and the less interorbital width distinguish this species from the *C. brevirostris*, as well as the longer muzzle and superior size adduced in my original description.

On this species and the *C. brevirostris* I proposed the genus *Lipomyzon*, on the supposition that the pharyngeal bones and teeth of *C. liorus* were like those of the genus *Catostomus*, from which those of these species differ in their greater attenuation. During the summer of 1882, I obtained a number of specimens of *C. liorus*, and find that while its pharyngeal bones are less attenuated than those of *C. luxatus*, they are more so than in some species of *Catostomus*, so that I cannot distinguish, generically, the species of Klamath Lake. The pharyngeals of *C. brevirostris* are not more attenuated than those of *C. liorus*.

CATOSTOMUS Les.

Catostomus labiatus Ayres. Cope, American Naturalist, 1879, p. 785.

This species abounds in Klamath and Goose Lakes, but I did not observe it in any of the lakes to the eastward of these. The formulæ are:—

Klamath Lake: scales, 10–74–11; radii D. I. 11; V.10; head 4·5 times in length; eye 5·5 times in head.

Goose Lake: scales 12-13—75—11; radii; D. I. 11; V. 10; eye 6; head 4·5 times in length.

The largest specimens measure twelve inches in length. Remains of species of this family are abundant in the pliocene sands of Oregon, but do not represent many species. Pharyngeal bones and teeth indicate that the species are true Catostomi.

Crania and other bones of one of the species have been found abundantly at Fossil Lake. In some of the specimens the

pharyngeal bones and teeth are preserved. I cannot distinguish the specimens from corresponding parts of the common sucker of Lake Klamath, named by Ayres as above. They, however, present considerable variations among themselves. These may be stated as follows:

I. Ethmoid and front convex transversely.
  a. Parietal fontanelle small. Two specimens.
  aa. Parietal fontanelle large. Three specimens; two of them lent me by Prof. Thos. Condon, of Eugene, Or.

II. Ethmoid and front a little convex; fontanelle large; in both points resembling the typical specimens from Lake Klamath. One specimen.

III. Ethmoid and front plane, the latter a little concave in profile. Fontanelle large. One specimen.

There are numerous other skulls in my collection, but they are not yet sufficiently cleared of matrix to display their characters.

Catostomus batrachops sp. nov.

This sucker is characterized by the short, wide and depressed form of the cranium. The ethmoid bone is considerably more than twice as wide as long (minus the spine), while in *C. labiatus* it is only half as long as wide. The interorbital width is equal to the length of the skull, minus the ethmoid bone and epiotic spine; in *C. labiatus* this width is a good deal less than the dimension mentioned. The ethmoid and frontal bones are less convex than is the case in the more common fossil variety of *C. labiatus.* Although the bridge separating the temporal and pterotic fossæ is wide in *C. labiatus*, it is wider in the *C. batrachops*, and has a concave superior surface, which is not separated by ridge or angle from that of the superior plate of the parietal bone. There is no frontal keel, and the fontanelle is well developed.

Measurements.	M.
Length from epiotic spine to ethmoid spine, inclus.,	·084
Length of ethmoid, minus spine, ...	·018
Length of frontal bone (median), ...	·032
Length of parietal bone (median), ...	·015
Interorbital width, ...	·056
Width at pterotics, about	·062
Width between apices of epiotics, ...	·032
Width of ethmoid, ...	·042

This species appears to have been about eighteen inches in length. The only skull which represents it was found by Charles H. Sternberg, near Silver Lake, Oregon.

Catostomus tahoensis Gill and Jordan. Synopsis Fishes N. Amer., 127.

This is the common species of the lakes which represent the Lahontan Basin. I found it in Pyramid Lake and the third Warner Lake. The formulæ are as follows:

Pyramid Lake: scales 14–89–14; radii D. I. 11; V. 9; head 4·5 times in length.

Warner Lake: scales 16–83–15; radii D. I. 11; V. 9; head 4 times in length.

PERCOMORPHI.

URANIDEA Dekay.

Uranidea minuta Pallas. Jordan Synopsis, p. 698.

Abundant in Klamath Lake; not seen elsewhere.

General Remarks.

The species noticed in the preceding pages may be enumerated with reference to their geographical distribution, in the following lists:—

I. Pyramid Lake.

Salmo purpuratus henshavi Jord.
Leucus olivaceus Cope.
Leucus dimidiatus Cope.
Siphateles lineatus Cope.
Squalius galtiæ Cope.
Chasmistes cujus Cope.
Catostomus tahoensis G. & J.

II. Fort Bidwell.

Apocope vulnerata Cope.
Apocope ventricosa Cope.

III. Warner's Lake.

Apocope vulnerata Cope.
Myloleucus formosus Gird.
Catostomus tahoensis G. & J.

IV. Goose Lake.

Myloleucus parovanus Cope.
Myloleucus thalassinus Cope.
Catostomus labiatus Ayres.

V. Klamath Lake.

Salmo purpuratus Pall.
Salvelinus malma Walb.
Myloleucus parovanus Cope.
Squalius cœruleus Gird.
Squalius bicolor Gird.
Chasmistes brevirostris Cope.
Chasmistes luxatus Cope.
Catostomus labiatus Ayres.
Uranidea minuta Pall.

VI. Silver Lake.

Salmo purpuratus Pall.	*Myloleucus formosus* Gird.

VII. Abert's Lake.

Salmo purpuratus Pall.	*Myloleucus formosus* Gird.
Apocope vulnerata Cope.	

VIII. Weber River, Utah.

Rhinichthys transmontanus Cope.	*Squalius montanus* Cope.
Agosia novemradiata Cope.	*Pantosteus platyrhynchus* Cope.

IX. Fossil Lake, Oregon. (Fossil.)

Leucus altarcus Cope.	*Catostomus labiatus* Ayres.
Myloleucus gibbarcus Cope.	*Catostomus batrachops* Cope.
Cliola angustarca Cope.	

Examination of the preceding lists discloses the following facts: (1). The species of *Leucus* replace in Pyramid Lake the *Myloleucus* of the other lakes. (2). All the species of Pyramid Lake are peculiar to it, excepting the *Catostomus tahoensis*, which is found in the third (and probably other) Warner Lakes, one hundred and fifty miles north of it. (3). The *Myloleucus formosus* inhabits the eastern line of lakes—Warner's, Abert's and Silver Lakes; while the *M. parovanus* is confined to the more western lakes, the Goose and Klamath. (4). The distribution of the Catostomi is similar; the *C. tahoensis* being the eastern, in Pyramid and Warner's Lakes, and the *C. labiatus* in the Goose and Klamath Lakes.

The distribution of the other species is not sufficiently known to enable us to draw any conclusions regarding them.

II. The Fauna of the Idaho Lake.

RAIIDÆ.

Raia pentagona Leidy. *Oncobatis pentagonus* Leidy, Proceeds. Phila. Academy, 1870, p. 70.

A species said to have been found in the beds of this deposit. It is referred to a new genus by Leidy, who, however, does not characterize it.

CYPRINIDÆ.

This family predominates over all others in the number of species and individuals. Typical carnivorous forms (*Squalius*) were not rare, but the greater number of genera are carnivorous with the teeth less (*Leucus*, *Myloleucus*) or more (*Mylocyprinus*)

adapted for crushing hard substances. The food of such species was probably mollusca. There were but few herbivorous forms, and these (*Diastichus* sp.) not typical, but related to the adjacent carnivorous genera. Especial interest attaches to the present distribution of some of the genera. *Diastichus* is the only one which is extinct, so far as known, though its characters approach those of existing genera so nearly, that it may be found at any time in the recent fauna. *Mylocyprinus* has a living species in China. *Leucus* is found in Europe and Asia. *Myloleucus* is American, and is confined to the lakes of the Great Basin and California; two species occurring in Utah and two in Oregon. *Cliola* is found in North America east of the Sierra Nevada. *Squalius* is generally North American and European.

MYLOCYPRINUS, Leidy.

Proceedings Academy Phila., 1870, 70. Cope, Proceeds. Amer. Philos. Society, 1870, 543. *Mylopharyngodon* Peters, Monatsberichte Berlin Academy, 1880, 925.

I am acquainted with three species of this genus; two extinct from Idaho, and one, the *Mylocyprinus æthiops* Basilewsky, (*Mylopharyngodon* Peters) recent, in China. The pharyngeal bones of these species may be distinguished as follows. I know those of the *M. æthiops* from a figure given by Prof. Peters.

I. Teeth commencing near the symphysis; curvature of pharyngeal very abrupt; apex shorter than tooth-row; *M. inflexus.*

II. Teeth commencing at a distance from symphysis, leaving a style; curvature gradual.

Style and apex each shorter than tooth-row; *M. robustus.*

Style and apex each longer than tooth-row; *M. æthiops.*

Mylocyprinus inflexus Cope, sp. nov.

Established on two pharyngeal bones of the left side, one of which indicates a fish of perhaps two pounds weight, and the other one of half the size. Its form is peculiar in the very abrupt curve of the external border, the great abbreviation of the style, and the shortness of the tooth series. The proximal and distal extremities of the bone are connected across the concavity by a thin expansion of the inner border, not seen in *M. robustus*. The first tooth is small, but larger than the corresponding one sometimes seen in *M. robustus*, so that I would be inclined to think it a permanent character, were it not wanting from the smaller specimen.

The second tooth is broadly molar. Two foramina perhaps indicate the position of two teeth of an internal row. The toothless apex of the bone is longer and flatter than in *M. robustus.* The entire bone is flatter than in that species. The first tooth stands on the edge of the symphysis.

Measurements.	M.
Total length on tooth row,	·025
Length of base of tooth row,	·018
Length of apex,	·016
Width at middle,	·018

Near Sinker's Creek, Idaho. J. L. Wortman.

Mylocyprinus robustus Leidy. Loc. cit. Report U. S. Geol. Survey Terrs., i, p 262, Pl. XVII, figs, 11-17.

This is the most abundant fish of the Idaho beds, and is represented by a great many pharyngeal bones with teeth, in my collection. These present a great many variations, and I have proposed in a former paper to recognize three species: *M. kingi*, *M. robustus* and *M. longidens.* Study of my material shows that these forms intergrade, and that if they represent distinct species, two others must be admitted. I incline to look upon the differences as due in part to age, and in part as subspecific variations. I tabulate them as follows:

I. Small; style more slender, five teeth in outer row, the upper very small and subprehensile; the lower small, conic.

II. Like the last, but the style stouter.

III. Like I, but only four teeth; the inferior tooth wanting.

IV. Like I, but four teeth; the superior larger and obtuse; *M. longidens.*

V. Larger; four teeth, the last obtuse but much smaller than the others; style stout; *M. robustus.*

VI. Larger; style stout; four teeth, the superior nearly as large as the others, which are equal; *M. kingi.*

The slenderness or stoutness of style is not coincident with the other characters, but the latter condition is always found in large specimens. In these the convex border is also much thickened. The small, partly hooked form of the superior tooth is only found in small fishes, and is probably a character of youth. It indicates that the genus is descended from more purely carnivorous types.

The minute first tooth is generally found in small specimens, but not always. It lingers in some to middle size. This species has not been found in the Oregon basin. The settlers call the pharyngeal bones "baby-jaws."

LEUCUS Heckel.

Fische Syriens, 1843, p. 48. *Anchybopsis* Cope, Proceed. Amer. Philos. Soc., 1870, p. 543.

Leucus latus Cope. *Anchybopsis latus* Cope, l. c.

Much the largest species of the genus, as yet only represented by two pharyngeal bones of opposite sides. Southern Idaho.

Leucus condonianus Cope, sp. nov.

This fish is represented by four pharyngeal bones, two of each side, which have the dental formula 2·5–5·2; the presence of the two inner teeth being doubtful on one of those of the right side. They indicate a smaller fish than the *L. altarcus*, and one about the size of the *Ceratichthys biguttatus*. The teeth display but little grinding surface, and have swollen subconic crowns, which are less expanded transversely than those of the *L. altarcus*. The style is moderately long and not much recurved. The external aliform border is rather full, and expands gradually from the style, not abruptly, as in *L. altarcus*. It is especially full opposite the superior extremity of the tooth series, where it is contracted in *L. latus*.

Measurements of Medium Size.	M.
Length on tooth line,	·014
Length of tooth line,	·007
Length of apex from tooth line,	·005
Width at middle,	·005

Dedicated to Professor Thos. Condon, of Eugene, Oregon, who first discovered and explored in part, the fossiliferous formations of the Oregon and Idaho basins.

SQUALIUS Bonap.

Jordan emend. *Ptychochilus* Agass. *Clinostomus* Girard. *Oligobelus* Cope, Proceeds. Amer. Philosoph. Soc., 1870, p. 540.

The American species generally differ from the type in the reduced number of teeth in the right pharyngeal series. The dental formula is 2·5–4·2, in our extinct and recent species. In the pliocene species here noticed, the teeth have acute, slightly incurved, apices. They differ from each other as follows:

I. Inner face just above superior tooth much narrower than anterior or posterior faces.

a. An external marginal expansion.

Width at fourth tooth equal length of bases of superior three teeth; an external bevel below first tooth; large; *S. posticus.*

Width at fourth tooth considerably less than length of bases of superior three teeth; a bevel below base of first tooth causing ala to be more distinct; large; *S. laminatus.*

Ala not projecting; width less than length of bases of superior three teeth; no bevel below first tooth; smaller; *S. reddingi.*

aa. No external ala.

Bone very narrow; teeth spaced; larger; *S. bairdi.*

II. Inner face just above superior tooth deep, equaling anterior and posterior faces.

No external ala; bone narrow; *S. arciferus.*

Squalius posticus Cope. *Semotilus posticus* Cope, Proceeds. Amer. Philos. Society, 1870, p. 541.

The original specimen is from Idaho. Only a fragment of two others are known.

Squalius laminatus Cope. *Oligobelus laminatus* Cope, loc., cit., 1870, p. 541.

Originally founded on a single fragmentary pharyngeal bone. A complete right-hand bone with all the teeth, found by Mr. Wortman, shows that this is as large a species as the *G. postica*, but of more slender proportions.

Squalius reddingi Cope, sp. nov.

This species is founded on pharyngeal bones of individuals of smaller size than those which represent the others mentioned in this list. They represent a fish of the average dimensions of the *Pogonichthys inæquilobus* of California. The five teeth occupy as much length as the style, and the apex is as long as the bases of four teeth and an interspace. The apex is flat, and its inner face is convex, and as deep at the base as one-half the width. The external alar expansion is slight but distinct, and originates opposite the third tooth from below. The style is not recurved.

Measurements.	M.
Length on tooth series, ...	·026
Length of tooth series, ...	·012
Length of apex from teeth, ...	·011
Width of bone at middle, ...	·005

One right and two left pharyngeal bones of this species were found by Mr. Wortman in Southern Idaho. It is named for my friend, the late Mr. B. B. Redding of San Francisco, Vice-President of the California Academy of Sciences.

Squalius bairdi Cope. *Semotilus bairdi* Cope, loc. cit., p. 542.

This species was established on a right pharyngeal bone which supported four teeth in the principal row. My original reference of it to the genus *Semotilus*, was based on supposition that the left pharyngeal bone would be found to support five teeth in the principal row. This is shown to be the case by such a bone discovered by Mr. Wortman. It belonged to a smaller individual than the typical one, and shows the very narrow basis of a probably shorter style than those seen in the other species here mentioned.

Squalius arciferus Cope. *Oligobelus arciferus* Cope, loc. cit., p. 541.

The most robust species, represented by parts of two pharyngeal bones.

DIASTICHUS Cope.

Proceedings Amer. Philos. Society, 1870, p. 539.

An entire pharyngeal bone of the typical species of this genus has five teeth in a single series. The opposite bone of another species presents also five teeth, so that the formula is probably 5–5. The teeth are compressed and short, and somewhat expanded transversely to the direction of the bone. They display an oblique grinding surface on use. They might then be referred to the genus *Leucus*, but the apical branch of the bone is much more elongate and is truncate at the extremity. This character is best seen in *D. macrodon*, where there appears to have been a superior as well as an inferior symphysis. The direction of the tooth series is at right-angles to this apical portion, as in other genera.

Diastichus macrodon Cope. Loc. cit., p. 539.

A specimen of pharyngeal bone, found by M. Wortman, is not more than half the linear dimensions of those obtained by Mr. King from the same part of Idaho.

Diastichus parvidens Cope. Loc. cit., p. 540.

No additional material.

Diastichus strangulatus sp. nov.

Represented by two pharyngeal bones from Southern Idaho.

One of these lacks the style, and the other the apical portion. The species differs from the *D. macrodon* in the flatter apical ramus, which is devoid of the marginal tuberosity and distal recurvature, seen in that species. It is straight and forms an acute angle with the axis of the tooth series. The style is short, stout, and somewhat recurved. The marginal ala is rather abruptly given off opposite the second tooth from below. The necks of the pharyngeal teeth are contracted, so that the internal and external outlines of the crown are convex. The grinding surface is quite oblique.

Measurements.	M.
Length of tooth line,	·014
Length of apical ramus,	·013
Width of bone at middle,	·010
Width of crown of tooth,	·005

This species was about the size of the gold-fish. From Southern Idaho, J. L. Wortman.

CATOSTOMIDÆ.

Catostomus shoshonensis sp. nov.

Of this fish I have two crania from the Idaho basin, one obtained by Mr. Wortman and the other by Mr. Clarence King. Two other crania, collected by the same gentlemen, represent a variety, or possibly another species.

The bones of the skull are relatively more elongate than those of the *C. labiatus*. The width of the superior surface of the parietal bones between the lateral angles is equal to two-thirds the length of the superior surface of the ethmoid bone posterior to the base of its anterior spine. The two measurements are equal in the *C. labiatus*. The ethmoid has three median longitudinal concavities and raised borders in the *C. shoshonensis*, but is regularly convex in the *C. labiatus*. The temporal fossa is separated by a narrow raised band from the pterotic fossa in the former, but by a very wide band in the latter. The supratemporal crests are not raised and sink gradually to the level opposite the posterior part of the supraorbital border. There is a slight median frontal keel which extends forwards from the same point. The frontoparietal fontanelle is well defined, elongate, and rather narrow. It commences at the base of the supraoccipital spine and extends to opposite the anterior foramen of the postfrontal bone. The bones of the skull are smooth.

Measurements.

	M.
Length from apex of epiotic to end of ethmoid spine, inclusive,	·075
Length of ethmoid without spine (median),	·018
Length of frontal bone (median),	·030
Length of parietal (median),	·0105
Interorbital width,	·028
Width at pterotics,	·040
Width between apices of epiotics,	·0245
Width of parasphenoid at middle of orbits,	·0070
Diameter (long) of hyomandibular cotylus of pterotic,	·0070.

The above measurements equal those of the largest size of the *Catostomus teres* of our waters. It will be desirable to compare its skull with that of *C. macrochilus* Gird., which comes from the Columbia River. Girard says that it is of more elongate proportions than that of the *C. labiatus*.

Catostomus cristatus sp. nov.

This species is known to me from a skull, of which only the cranium posterior to the anterior orbital region remains. It belongs to the same elongate type as the *C. reddingi*, and differs from that species as follows:—

The lateral casts of the frontal bone are more elevated, and are carried farther forwards. Instead of gradually disappearing anteriorly, they descend abruptly to their termination, enclosing a groove with the supraorbital plate of the frontal. The fontanelle is wide, and extends farther into the frontal bone. The low median frontal ridge commences at its anterior border. The bridge between the temporal and pterotic fossæ is narrow. There is a transverse ridge on each half of the supraoccipital bone; in *C. reddingi* this ridge is oblique, descending towards the middle line.

Measurements.

	M.
Length of parietal bone (median),	·014
Length of frontoparietal fontanelle,	·023
Width at pterotics,	·046
Width between frontal crests at anterior extremities,	·014
Width between apices of epiotics,	·024
Diameter (long) of hyomandibular cotylus,	·008

Found by J. L. Wortman in S. W. Idaho. One specimen only.

COBITIDÆ.

A species of this family left remains in the Idaho Lake basin. I have reached this conclusion by the discovery, among the specimens submitted to me by the Smithsonian Institution, of the inferior element of the three modified anterior vertebræ,[1] which are so characteristic of certain families of the Physostomous fishes. This portion, moreover, is that which occupies the position among the Cobitidæ only. Among them, it consists of a longitudinal plate terminating posteriorly in a bladder-like chamber on each side, each of which is closed below by a transverse process of the inferior plate; an angular fissure extends around the ends of these, and at the angle sends a short continuation upwards. This is quite similar to what is observed in *Cobitis*.

This occurrence of *Cobitidæ* is, perhaps, the most interesting fact brought to light by the examination of these extinct fishes. All of the numerous existing species of this family are found in the Eastern Hemisphere, and the great majority in tropical Asia, a few only occurring in Europe and South Africa. Extinct species are found in the miocene of Oeningen. We have then, in this form, another example of the occurrence of Asiatic types in North America prior to the glacial epoch; and as in a fresh-water fish, more strongly demonstrative of continuity of territory of the two continents, than can be with any other type of animal.

SALMONIDÆ.

RHABDOFARIO Cope.

Proceeds. Amer. Philosoph. Society, Nov., 1870.

A genus represented by skulls, in which the maxillary bone is cylindrical and rod-like, thus differing from *Salmo*.

Rhabdofario lacustris Cope, l. c.

A species with a head as large as that of the *Salmo salar*, which was not uncommon in the Idaho Lake. In addition to the type obtained by Mr. King, Mr. Wortman found parts of several individuals.

SILURIDÆ.

AMIURUS Raf.

? Amiurus sp.

Represented by pectoral spines. These do not differ from those of some recent species, but differ from those of the species of

[1] The pharyngeal bones referred to this family by me as above cited, belong to the Cyprinidæ in the restricted sense. See genus *Diastichus*.

Rhineastes from our eocene beds, except perhaps the *R. arcuatus*, in the possession of but one row of teeth. The surface is delicately striate. The anterior edge is smooth and acute, and the posterior edge has two rows of serræ separated by the usual groove.

COTTIDÆ.

COTTUS L.

I refer to this genus four species from the Idaho beds. They may belong to *Uranidea*, but as I can only identify them as yet by the preopercula, I cannot determine this point. The parts in question are not rare, showing that this type was well represented in this region.

The preopercular bones are furnished with three or four acute spines of no great length. In this they differ from the living American species of *Uranidea*, which have only one or two spines, excepting the *U. spilota*, which has (*fide* Jordan) four spines, three of which are inferior. The four species of the present collection differ in their prominent features, as follows:—

a. Foramina on inner side of preoperculum.

Four spines; angular spine directed backwards; inferior ones forwards; smaller; *C. divaricatus.*

Angular spine directed backwards; posterior inferior downwards; inner side with two faces separated by an angle; larger; *C. pontifex.*

aa. Foramina on the posterior edge of preopercle.

Angular spine directed backwards; two strong similar inferior spines turned forwards; larger; *C. cryptotremus.*

aaa. No foramina.

Angular spine directed downwards; inferior spines forwards; the anterior inferior flattened; large; *C. hypoceras.*

Cottus divaricatus sp. nov.

Represented by two preopercula. These indicate the smallest of the four species, and one about equal to the *C. richardsoni*, Ag. The preoperculum is flatter and thinner than in the other species, and the foramina are all on the inner side of the branches. These are: one large one above base of superior spine, one small one between bases of superior and angular spines, one do. between bases of angular and posterior inferior, and one at anterior base of posterior inferior. The two inferior spines are smaller than the others, and are incurved. The superior posterior is the largest

and is curved upwards, and compressed at the base. Both external and internal faces are flat.

Measurements.	M.
Length from base of superior to base of exterior inferior spines, inclusive, ...	·008
Length of superior spine above, ...	·003

From Willow Creek, Oregon. J. L. Wortman.

Cottus pontifex sp. nov.

The preopercular bone of this species is robust, especially in the transverse diameter. Instead of being flat as in *C. divaricatus*, it presents two faces on the side which is perforated by foramina, which are separated by a vertical angle. The anteroexterior face is flat, while the posteroexternal is somewhat irregular. The foramina which pierce it are larger than in any other species, especially the one between the second and third spines. The foramina communicate below the surface, the canal thus formed being spanned by a narrow bridge from the base of each spine. The opposite side of the preoperculum is a little concave, and plane at the base of the spines. The bases of the superior and the angular spines are closer together than in any other species, being absolutely in contact.

Measurements.	M.
Length of three upper spines on bases, incl., .	·008
Length of joined bases of two upper spines, .	·005

It is not possible to be certain whether there is any anterior inferior spine. One specimen was obtained by Mr. Wortman, probably from Willow Creek, Oregon.

Cottus cryptotremus sp. nov.

A larger species, very different from the last, and nearer the *C. divaricatus*. Three preopercula are in my collection. In all the specimens the superior limb is broken off, so that it is impossible to state the character of the superior spine. The angular spine has a round section and is directed backwards, and in line with the inferior border. The two inferior spines are at a little distance from its base, and are well developed, acute, and of equal size. They are directed forwards and inwards. The external face of the inferior limb is divided by a prominent obtuse angle on its entire length. There is a small foramen at the posterior

base of each inferior spine, and a large one at the anterior extremity of the inferior branch, looking partially outwards.

Measurements.	M.
Length of base of three inferior spines, incl., .	·0085
Length of inferior spines, inclusive, . . .	·0055
Length of anterior inferior spines, . . .	·0045
Length of inferior branch of bone, . . .	·0140

Discovered by Mr. J. L. Wortman, Castle Creek, Idaho.

Cottus hypoceras sp. nov.

The preoperculum of this species differs widely from those of the three already described. Although it has four spines, they are distributed differently, three being inferior and one posterior, instead of two posterior and two inferior. The base of the posterior spine is less compressed than in the others, and looks as though the apex is directed posteriorly instead of superiorly as in *C. divaricatus*, and *C. pontifex*. It is opposite the inferior branch instead of above it as in the species named. The angular spine is round at the base; the first inferior is compressed at the base, and the anterior is compressed to the rounded apex, its superior edge being acute, the inferior rounded. This spine therefore differs from that of any of the other species.

The external face is gently rounded, and is smooth. The internal face has the usual excavation with bordering rim, and is roughened. There are no foramina except two above the base of the anterior inferior spine. In size this species is about like the *C. pontifex.*

Measurements.	M.
Length of base of four spines, inclusive, in a straight line, ...	·011
Length of bases of anterior two inferior spines inclusive, ...	·007
Length of angular spine, ...	·004
Elevation of vertical limb of preoperculum, . .	·012

One specimen; obtained by Mr. J. L. Wortman, probably at Willow Creek, Oregon.

PERCIDÆ.

The spines of the dorsal fin of a species of this family are not rare in the formation, but I have not yet been able to fix them generically or specifically.

GENERAL OBSERVATIONS.

In the preceding pages there are described from the Idaho pliocene formation the following species :—

Percidæ,	1	species.
Cottidæ,	4	"
Salmonidæ,	1	"
Cyprinidæ,	11	"
Catostomidæ,	2	"
Cobitidæ.	1	"
Siluridæ,	1	"
Raiidæ,	1	"
Total,	22	species.

Of the above, all differ from existing species so far as known, but three of the species which represent the *Percidæ*, the *Cobitidæ* and the *Siluridæ* respectively, have not been exactly determined. All the species differ from those of the Oregon Lake (or Lake Lahontan as it may prove to be). Of the families, all are existing and all are represented on the North American Continent excepting the *Cobitidæ*, which are now confined to Eur-Asia. But of these eight families four are not now found in the American waters which empty into the Pacific Ocean, viz., the *Percidæ*, *Siluridæ*, *Cobitidæ*, and *Raiidæ*, excepting that there is one species of the Percidæ in California. Five of the seven families have not yet been found in the Oregon fossil lake basin, but as two of them (*Salmonidæ*, *Cottidæ*), are found in the existing lakes of that region, they will probably be found in that deposit.

The above evidence is sufficient to prove that the Idaho pliocene formation is distinct from any formation previously known. It is older than the Oregon lake deposit.

In addition to the fishes, three species of craw-fishes were discovered in this formation by Capt. Clarence King. These I named *Astacus subgrundialis*, *A. chenoderma*, and *A. breviforceps*.[1] The mollusks of this formation have been described by F. B. Meek, and they, like the fishes, determined it to be lacustrine and fresh, as already stated by Prof. Newberry. The species are stated by Meek[2] to be distinct specifically, and in some cases

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[1] Proceedings Amer. Philos. Society, 1870, p. 605. Loc. cit., Nov. 1870.

[2] Proceedings Acad. Nat. Sci., Phila., 1870, 56.

generically, from all others hitherto described from the West. Leidy observes,[1] that mammalian remains received from Capt. King's expedition include portions of *Mastodon* and *Equus excelsus*. Mr. Wortman obtained teeth and bones of the latter, and a cannon-bone of an undetermined ruminant of the size of the *Cervus elaphus*. The ungual phalange of an edentate allied to *Megalonyx* was obtained from the same horizon and locality.

The map of the adjacent parts of Oregon, Nevada and California, showing the lakes, is copied from the map issued by the War Department of the United States, Brig. Gen. A. A. Humphreys, Chief of Engineers.

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[1] L. c., 1870, 67. On Cretaceous and Tertiary Reptilia and Fishes, by Prof. E. D. Cope, November, 1870.

121
120
43
42
41
40
KLAMATH INDIAN
RESERVATION
Klamath Marsh
Swamp L.
Whitehill
Chewaucan
Yainax
Sprague River
Bonanza
Lost River
Tule Lake
Langells Valley
Lava Beds
Lake View
Old Camp Warner
Beatie's Butte
Warner L.
Guano L.
New Year L.
Ft. Bidwell
Davis C.
Lake C.
Middle L.
West L.
Alturas
Canby
Middle Lake
Eagleville
Big Valley
Bieber
Camp Crook
Adin
Hayden
Providence City
MADELINE PLAINS
Madeline
Horse L.
Eagle L.
Merrillville
Susanville
Willow Creek
Honey L.
Camp McKee
Black Rock
Smoke Creek Desert
Quincy

JULY 3.

Prof. EDW. D. COPE in the chair.

Seventeen persons present.

A paper entitled "Description of a New Hydrobiinoid Gasteropod from the mountain lakes of the Sierra Nevada, with remarks on allied species and the physiographical features of said region," by R. E. C. Stearns, was presented for publication.

The death of Isaac T. Coates, a member, was announced.

On some Fossils of the Puerco Formation.—Prof. COPE stated that he had recently received from the Puerco beds of New Mexico remains of a number of individuals of the extinct mammal he had named *Periptychus ditrigonus*.[1] Besides jaws and teeth with permanent and temporary dentition in good preservation, the pelvis, femur and tibia are included in the specimens. These show that the species must be referred to the genus *Conoryctes* Cope, and render it very probable that the genus belongs to the family of the Periptychidæ. The absence of ungual phalanges prevents absolute certainty. The genus is near *Periptychus*, but differs in the one root and simple conic crown of the second true molar in both jaws, and the presence of cingular cusps of the superior molars, exterior to the external tubercles. *Conoryctes ditrigonus* has the molars of both jaws larger than those of the *C. comma*, and there is less difference in size between the posterior and anterior teeth than in that species.

The following new species accompanied the above:

PERIPTYCHUS COARCTATUS. This species represented by teeth of the lower jaw, viz.: one incisor, three premolars, and two molars, two of the latter imperfect. The characters of the species are well marked in the premolar and molar teeth. The former lack the anterior and internal ledges of the *P. carinidens* and *P. rhabdodon*, having only a prominent ledge-shaped heel, besides the principal conical cusp. The true molars lack the small tubercle which is between the pair of threes which compose the crown. The adjacent cusps of the threes are connected by low longitudinal ridges instead of oblique ones. The cusps themselves are closer together than in the other species, especially those of the anterior three, which are closely approximated. The anterior one is small and low. The enamel is grooved as in the other species.

Diameters of crown of fourth premolar: anteroposterior, ·0115; transverse, ·0115; elevation (worn), ·010. Diameters of crown

[1] Proc. American Philos. Society, 1882, p. 465.

of second true molar: anteroposterior, ·011; transverse, ·009. From the Lower Puerco beds. D. Baldwin.

PANTOLAMBDA CAVIRICTUS sp. nov. Represented by a nearly entire mandibular ramus with all the teeth represented excepting the crowns of the incisors. The characters are seen, first in the large size, the teeth having twice the linear dimensions of those of the *P. bathmodon;* and second, in the lateral prominence of the inferior edge of the ramus, which produces a concavity of the side of the jaw posterior to the canine teeth. It is the largest mammal known from the Puerco formation.

The inferior canines are strongly curved, so that the crown is directed upwards and a little backwards. Both root and crown have a round section, but the apex of the crown cannot be described, as it is greatly worn by use in the specimen. The incisive border is regularly convex, and the three incisors are not of large size, the first being least, and the third largest. The premolars and molars have the form of those of the *P. bathmodon.* The latter present two V's, the anterior narrower and more elevated. In the former the posterior V is represented by a short crest. The last molar is produced into a heel, which supports the posterior branch of the posterior V, and no cusp. The first premolar is one-rooted, and is separated from the second premolar by a moderate diastema. The symphysis is not long, is regularly curved upwards, and has a flat inferoanterior face. The canine alveoli create a marked prominence on each side.

Measurements.—Depth of ramus at diastema, m. ·045; do. at third premolar, ·056; width of ramus below third premolar, ·021; length of bases of three incisors, ·023; diameters of canine at base: anteroposterior, ·018; transverse, ·018; diameters third premolar: anteroposterior, ·012; transverse, ·011; diameters first true molar: anteroposterior, ·077; transverse, ·014; diameters third true molar: anteroposterior, ·022; transverse, ·014.

The jaw of this species is about the length of that of a large tapir, but is deeper and more robust. The flare of the inferior edge in front is suggestive of the structure seen in the *Dinocerata*, and of the probability that the Taligrada (to which *Pantolambda* belongs) are the ancestors of that suborder as well as of the Pantodonta. The flare is related to the flange of *Uintatherium*, exactly as the similar ridge in *Nimravus* is to the flange in *Machærodus*.

ZETODON GRACILIS, gen. et sp. nov. *Char. Gen.*—This genus and species are founded on a broken lower jaw which contains the second and part of the first true molars, and the fourth premolar. The teeth are of very peculiar character. True molars consisting of narrow crescents in two pairs, which are both concave towards each other, embracing a fossa. The posterior crescents soon unite on attrition, closing the fossa, while the anterior are well separated, and only unite by their anterior apices. Each molar has a

small columnar heel. Fourth premolar with the posterior pair of crescents only, which soon unite. The anterior pair is represented by a part of the external one, which forms a narrow lobe. The heel is larger than in the true molar.

The position of this genus it is impossible to determine from the specimens in my possession. It may be Marsupial or Condylarthrous, and if the latter, one of the *Meniscotheriidæ*; but if not of these groups, its position is not likely to be in any known order of the tertiary periods.

Char. Specif.—Crowns compressed, deeply grooved at the points of junction of the crescents. This is effected by a narrow lamina from the anterior inner to the posterior outer; the anterior outer being free posteriorly, excepting after considerable wear. A groove on the external side of the crown distinguishes the heel, which sinks into the crown below. It is larger on the first than on the second molar. The heel of the fourth premolar is elevated on its posterior edge. No cingula except a weak one at the exterior base of the posterior lobe of the true molars, and at the anterior base of the anterior lobe of the fourth premolar. Ramus compressed; but little of it preserved. Diameters of p. m. iv.: anteroposterior, ·0055; transverse, ·0020; of second true molar: anteroposterior, ·0045; transverse, ·002. From the lower red bed of the Upper Puerco epoch. D. Baldwin discoverer.

JULY 10.

Mr. CHARLES MORRIS in the chair.

Twenty-eight persons present.

A paper entitled "Preliminary Observations on the Brain of Amphiuma," by Henry F. Osborn, was presented for publication.

JULY 17.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

Sixty-two persons present.

JULY 24.

Mr. JOHN H. REDFIELD in the chair.

Fourteen persons present.

JULY 31.

Mr. J. H. REDFIELD in the chair.

Eleven persons present.

The following were ordered to be printed:

DESCRIPTION OF A NEW HYDROBIINOID GASTEROPOD FROM THE MOUNTAIN LAKES OF THE SIERRA NEVADA, WITH REMARKS ON ALLIED SPECIES AND THE PHYSIOGRAPHICAL FEATURES OF SAID REGION.

BY ROBERT E. C. STEARNS.

The interesting form herein described was first brought to my notice through the kindness of Mr. Xenos Clark, son of the lamented Prof. Henry James Clark, in 1879. Owing to ill-health and other causes, it has remained undescribed until this time. Recently I have been stimulated to inquire into its characters and relationship, by the reception of a letter and further specimens from Prof. R. Ellsworth Call, who, while believing it to be undescribed, thought possibly it had been made known by some of our West Coast naturalists, and wrote to me for information.

While it appears to have certain analogies with *Lioplax* of the Viviparidæ on the one side (see *L. subcarinata* Say), and with the Strepomatidæ (see the carinated Goniobases like *G. torulosa*[1] Anthony), on the other, yet the sum of its characters, inclusive of faunal and geographical relationship, seems to me to point rather in the direction of the fresh-water Rissoids. The late Dr. Stimpson's genus *Tryonia* applies only to shells with a "surface longitudinally ribbed or plicated," as distinct from the usual smooth-surfaced shells of the various groups embraced in his "Researches, etc."[2] He includes, however, the little group *Pyrgula* of Cristoforo and Jan, and arranges it directly preceding *Tryonia*, which my judgment confirms as being its proper place.

Woodward[3] included this genus (*Pyrgula*) in his synonymy of *Melania*; he also placed *Amnicola* as a subgenus of the foregoing. H. and A. Adams[4] place *Pyrgula* with the Melanians, but *Amnicola* is grouped by them with the Rissoidæ. They further include

[1] L. and F. W. Shells of N. A. Part IV, p. 229, S. T. Miss. Coll., 253. See also Meek and Hayden's Tertiary *Goniobasis tenuicarinata*, Proc. Phila. Acad. Nat. Sci., 1857, p. 124, and *G. nebrascensis*, id., 1856, p. 124. Also Wheeler's Report. Palæontology, vol. iv, and Hayden's Inv. Palæontology, vol. ix.

[2] Researches upon the Hydrobiinæ and allied forms. Smiths'n Misc. Coll., 201.

[3] Recent and Fossil Shells, 2d ed., pp. 246, 247.

[4] Adams' Genera, pp. 306–308, vol. i.

the genus *Tricula* of Benson with the Melaniidæ, an arrangement which has been followed by Chenu.[1]

Benson's *Tricula* is based upon a small fluviatile form which the Adams say "somewhat resembles *Paludomus;* * * * * the only species known is an inhabitant of the River Kamaan in India." The specific name *montana* implies a station similar to those inhabited by the various species of *Pyrgula* herein quoted. The figure of *Tricula* as given by the Adams and Chenu, together with the totality of testimony furnished by said authors, leads me to suspect that the Indian species should be removed from the Melaniidæ to the Hydrobiinæ and near to *Pyrgula.*

It is not without some little hesitation that I place the Sierra Nevada shell in the genus *Pyrgula.* Its principal characteristics, however, indicate said group as well as the environmental features. Stimpson's generic description of *Tryonia* applies only to shells longitudinally sculptured ("ribbed or plicated"), a too restricted limitation for a generic standard in this case, because if literally applied it would exclude ninety-five per cent. of the individuals which form the mass of which Stimpson's[2] species is but a rare varietal aspect. Upon this point he wrote: "In company with the Tryoniæ, Mr. Blake found a small cancellated shell, which has been described as *Melania exigua* by Conrad, and as *Amnicola protea* by Gould. In view of the character of the surface, I think it scarcely possible that this species can belong to the Hydrobiinæ. It will, perhaps, be found to be allied to *Bittium.* The occurrence of this marine or brackish-water genus in the Desert would not be surprising, since *Gnathodon* was found in the same basin at a point somewhat nearer the Gulf." It is quite evident to my mind that Stimpson could not have had a very large number of specimens as they are usually found; if so, they would have included not only his *T. clathrata*, as well as Conrad's and Gould's types, but intermediate and connecting varieties, sufficient to have caused him to expand his generic diagnosis, and either to have made him hesitate before investing the variety before him with specific dignity, or else to have included Conrad's and Gould's forms as species of *Tryonia.* He was not aware of the countless millions of these tiny shells, that are scattered over a vast area, or of the depth of the fresh-water sedimentary deposit throughout which

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[1] Manuel de Conchyliologie, etc., p. 294, vol. i.

[2] Researches, etc., etc., *id.*, p. 48, *et seq.*

they are distributed. At Walter's Station, on the Southern Pacific Railroad, the perpendicular section exhibited by the digging of a well to the depth of forty-seven feet, contained these shells from the surface of the desert to the bottom of the well.[1] Again, in suggesting relations between Conrad's and Gould's forms with *Bittium*, a genus belonging to the brackish-water division or subfamily (Potamidinæ) of the Cerithiidæ, he seems to have overlooked the fact that the longitudinally plicated sculpture of his species is a character common also to the brackish-water genus *Cerithidea*, which belongs as well as *Bittium* to the Potamidinæ.[2]

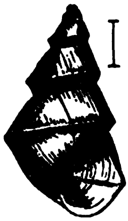
Had Stimpson's generic definition of *Tryonia* been more ample I should have been tempted to have given the shell herein discussed a place in said group rather than *Pyrgula*, which latter, as figured by the Adams and Chenu, shows an angular termination to the aperture at the base of the columella, indicative of a more pronounced feature in the soft parts (siphonal) at this point than the rounded aperture of *Tryonia* and *Tricula* (as figured), and the form before me presents. This, however, is a somewhat variable feature as between individuals of the same species, and still more so between forms of one species as compared with forms of another.

With the concurrence of Prof. Call, I have described the shells received from him and Mr. Clark as follows:

Genus **PYRGULA** Cristoforo and Jan.

Pyrgula Nevadensis, n. s.

Shell small, elongated, ovate-conic, turreted; number of whorls five to six (5–6), with a conspicuous keel following spirally the periphery of each and terminating near the middle of the outer edge of the continuous peritreme, which is otherwise simple, ovate and slightly effuse, and appressed (to the whorl) above; in some specimens somewhat produced on its inner side and suggesting a faint umbilicus. Shell white or nearly so; smooth and glossy, with a slight epidermis on



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[1] For further information on this point, see my remarks on the "Fossil Shells from the Colorado Desert," in Am. Naturalist, March, 1879.

[2] The connection of the marine Cerithiidæ with the fresh-water Melaniidæ through the brackish-water Potamidinæ, seems natural and logical. In this connection the remarks of Swainson in his "Treatise on Malacology," are well worth perusing.

some specimens. Dimensions as follows, being the measurement of ten (10) specimens, all adult:

Longitude	·14,	Latitude	·08	inch.
"	·15,	"	·08	"
"	·16,	"	·09	"
"	·17,	"	·09	"
"	·17,	"	·09	"
"	·18,	"	·10	"
"	·18,	"	·10	"
"	·22,	"	·10	"
"	·22,	"	·11	"
"	·21,	"	·12	"

The mean of the above measurements is eighteen-hundredths of an inch in length by ninety-six-thousandths of an inch in breadth, or very nearly two to one. The largest specimen measured ·23 by ·13 inch. Aperture about one-third the length of the shell, being as forty-one to one hundred and twenty ($\frac{41}{120}$). Of the sixteen specimens examined[1] *nine* are from Pyramid Lake (Clark), and *seven* from Walker's Lake (Call).

The Pyramid Lake lot, from Mr. Clark, were accompanied by specimens of the flat-spired form of *Pompholyx effusa*, to which Dr. Dall has given the name of "*var. solida.*"[2]

The several specimens of *Pyrgula Nevadensis* exhibit similar differentiation as *Tryonia* in size of mouth, variability in coil, robustness or attenuation; and many of the specimens from the alkaline deposit of the lake bottom are discolored, varying from light ashen slate to dark slate, approaching black.

In connection with the above, I have to thank Professor Call for the following notes:

"I have it as collected by the U. S. Geological Survey the past

[1] Subsequently thirty-two specimens, adolescent and mature, from the dredging "(1)" Pyramid Lake; and about the same number, young and adult, from "(2)" North Shore, Pyramid Lake, were received from Prof. Call and examined with care.

[2] Annals of Lyceum of Nat. History of N. Y., March, 1870, p. 334. The locality here given, through some misapprehension, is "Clear Lake," which is in California; it should read "White Pine, Eastern Nevada." Dall, in *Science*, vol. i, No. 7, page 203 (March 23, 1883), refers to the occurrence of *Pompholyx effusa* in a calcareous deposit in Pyramid Lake, and remarks on its variations.

summer. Where known, I give the name of the collector as authority for locality. (1) From dredgings of Pyramid Lake bottom; *Russell* (I. C.); August 30, 1882. (2) North side of Pyramid Lake, Nevada; *Russell* (I. C.). (3) In tufa, shore of Walker's Lake, Nevada; *Russell* (I. C.), and also loose. This is the locality represented by the shells sent to you.

"Pyramid Lake,[1] although it receives the fresh water of the Truckee River, the outlet of that gem of lakes, Tahoe, is very strongly alkaline, and the water is not good for human use, although it can be used for a short period without much inconvenience."

The elevation of Pyramid Lake is 4890 feet, as stated in Gannett's[2] List, etc., and Walker's Lake, according to the same authority, has an altitude of 3840 feet. The water of this lake is probably similar to that of Pyramid; it is brackish, as I have been informed by Prof. Joseph LeConte.

These lakes are the remnants of the great tertiary lake which covered this general region, and are the pockets or deeper depressions in the floor of the ancient lake; the bitterness of their waters being the result of the accumulated alkaline and saline sediments, or dregs, of centuries.

Assuming that I have placed the above form in its proper position, much greater interest attaches to it than that of the addition of a new species to the fauna of the general region within which it is found, or that of adding a peculiar type to the living molluscan fauna of the North American continent.

The species of *Pyrgula* heretofore described,[3] are the type, *P. helvetica*, from Switzerland; *P. bicarinata*, France; *P. pyrenaica*, from the Pyrenees; and *P. andicola*, from the Andes of Bolivia.

Its distribution hitherto, it will be seen, is Europe and South America; inhabiting, as Stimpson observed, "fresh waters in mountainous regions," and as he further remarked, "It is interesting to notice that all the species of the genus as yet described are severally reported to occur in mountainous districts; an instance of correlation of form to external conditions."

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[1] Lieut. Symons, in Lieut. Wheeler's Report Geog. Survey, etc., 1878, p. 114.

[2] U. S. Geol. Survey. Hayden, Misc. Pub., No. 1. Fourth Ed.

[3] *Vide* Stimpson, *ibid.*

These facts tend to give this new species[1] its chief importance, and point to further interesting discoveries.

Specimens of *Pyrgula Nevadensis* have been distributed to the Museum of the Acad. Nat. Sci. Phila.; the U. S. National Museum, Washington; the Museums of the University of California and California Acad. of Sciences; and are contained in the cabinets of Professor A. E. Call and my own.

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[1] Mr. John Wolf has described *Pyrgula scalariformis* from the post-pliocene of Tazewell, Illinois River. *Vide* Tryon, in Proc. Acad. Nat. Sci. Phila., May 1, 1873.

PRELIMINARY OBSERVATIONS UPON THE BRAIN OF AMPHIUMA.

BY HENRY F. OSBORN, SC. D.

The North American Urodela, embracing a wide variety of forms which can readily be obtained, offer an attractive field for the comparative study of the amphibian brain. The work upon the subject hitherto has been chiefly in Germany, but many members of this large group have barely been touched upon, so that a systematic research into the whole subject would form a valuable contribution to Comparative Morphology.

In the hope of extending my study later I have recently been investigating the brain of *Amphiuma*,[1] having procured a quantity of live specimens from New Orleans. This paper contains a preliminary account of this investigation.

Among the more important studies upon the amphibian brain are those of Wyman,[2] Fischer,[3] Stieda[4] and Wilder.[5] Stieda's work is principally upon the microscopic structure of the brains of the Frog and Axolotl; Wilder, in his study of the Frog and Menobranchus, has directed attention largely to parts of the brain which have been less studied hitherto, namely to the cavities and the thinner portions of the brain parietes surrounding them, as well as to the brain membranes. I am indebted to the writings of both of these authors for light upon this subject, although I have not as yet so fully consulted either as I would like to do.

In the general description the usual terminology of different portions of the brain is employed, but in referring to the various segments of the brain tube and to the ventricles they enclose I largely employ the terms partly adopted and partly introduced by Wilder. His system of nomenclature, which is chiefly founded upon the embryonic divisions of the brain, is admirably clear and

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[1] I employ this title as it is the family name (*Amphiumidæ*), and is more generally known, although *Murænopsis*, the three-toed genus, is the one which I studied.

[2] Smithsonian Contributions to Knowledge, Washington, 1853.

[3] Amphibiorum Nudorum Neuroglia; also, Anat. Abhandlungen über die Perennibranchiaten und Derotremen.

[4] Zeitschrift für wiss. Zoologie, Band xx, xxv.

[5] Anatomical Technology, Wilder and Gage, 1883.

consistent, although objections may be raised to the author's means of indicating position and direction.[1]

My method of study was: (1) A careful examination of the external features of the brain. (2) A series of very thin transverse and longitudinal sections of the brain, the sections after staining being carefully mounted in serial order. These series naturally supplement each other and give a very accurate idea of the gross and minute structure.

The technical process of preparing the brains was as follows: They were hardened, after removal from the skull, in a saturated solution of bichromate of potash, the acid being subsequently removed with alcohol of different densities. The brains were then embedded in an egg-mass prepared by shaking the white and yolk of egg together, with three drops of glycerine to each egg. This mass was first stiffened around the brain by placing in a vapor of alcohol, then hardened in absolute alcohol until ready for cutting. Its advantages are that it closely embraces the brain, holding all the parts together and becoming transparent in oil of cloves. The section cutting was done with one of the large instruments manufactured by Jung, of Heidelberg, which is far superior to any other instrument of its kind now in use.

External Structure. The brain of *Amphiuma* (Plate VIII, figs. A and B) resembles that of *Menopoma* (figs. C and D) more closely than that of any of the remaining Urodela. Its most striking feature is that the component parts are, in the main, little differentiated from each other, giving the exterior very much the simple character of an embryonic brain. This is especially true of the Di-, Mes- and Epencephala. The vertical longitudinal section (fig. H) shows that the construction of the interior is equally simple. The brain flexure is apparently slight. The brain is also extremely small in proportion to the body, and has a narrow, elongated form; a remarkable feature is the diminutive

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[1] The following are some of the terms employed and their synonyms: *Rhinencephalon*, olfactory lobes; *Prosencephalon*, including the cerebral hemispheres and their cavities (*procœliæ*); *Diencephalon*, including the thalami optici, the infundibulum, the pineal gland, etc., and the *diacœlia* or third ventricle; *Mesencephalon*, including the optic lobes, the crura cerebri and *mesocœlia* or iter; the *valvula*, or valve of Vieussens; *Epencephalon* or cerebellum; *Metencephalon*, medulla oblongata, and roof of fourth ventricle.

size of the cerebellum. This general simplicity corresponds to the partial blindness and to the degenerate structure and habits of *Amphiuma.*

The *Metencephalon* is very broad and shallow, with its upper surface divided longitudinally by a central and two slight lateral furrows, and with its borders turning bluntly inwards anteriorly, apparently to enter the cerebellum. On its lower surface the medulla is divided by the central furrow, a continuation of the anterior fissure of the spinal cord. As in other Amphibia, the medulla passes without clear demarkation into the crura cerebri.

The *Epencephalon.* The cerebellum is a narrow, band-like structure, arching across the wide medulla. It is unusually small, and was actually overhung by the optic lobe in my specimens, so as not to be seen in the median line, although this point may require confirmation. The valvula is therefore out of sight, in the dorsal aspect of the brain, but may be seen in the longitudinal sections.

The *Mesencephalon.* The optic lobe has no longitudinal furrow, but forms a single, narrow, unpaired body, passing forward into the roof of the Diencephalon without demarkation. These divisions of the brain cannot be distinguished upon the dorsal surface, but can be seen in side view by noting the position of the infundibulum below. The *Crura* (pars peduncularis) form a broad base for the posterior half of the Mesencephalon, which, by an oversight, is not represented in the drawings. As they pass forward, however, they cannot be distinguished from the optic lobe nor from each other, so that this division of the brain forms a cylindrical tube, the component parts of which can only be detected in the microscopic structure.

The *Diencephalon.* The roof of this portion of the brain terminates anteriorly in the large pineal gland; its median surface is marked, in *Menopoma*, by two circular thickenings which were not noticed in *Amphiuma.* These may correspond to several structures in the brain roof, which are apparent in the sections. The sides of the Diencephalon form the thalami, but the prominent feature of this portion of the brain is the production of the floor into the long, backward-directed infundibulum, which is best seen in side view. At the base of this process is the large pituitary body. At the sides of the infundibulum are two thickenings which converge to enter the thalami; their relations are clearly

shown in the sections. In front of the infundibular region the Diencephalon as a whole becomes higher and narrower. There is quite a space between the infundibulum and optic chiasma; the latter has no clear decussation of fibres as in the frog; on the other hand, the nerves are given off as two slender fibres on either side of a slightly raised whitish plate.

The *Prosencephalon*. The cerebral hemispheres are very long, flattened-oval bodies, narrowing forwards; they are in close contact, but there is no structural union, except for a short distance in front of the lamina terminalis. The *Rhinencephala* arise from the outer anterior third of the hemispheres and give off on the lower surface of the brain, the large olfactory nerves.

Internal and Microscopic Structure.

The internal structure of the brain, so far as studied, has many interesting features, which may here be considered in connection with the various divisions of the brain tube, concluding with some observations upon the general distribution of the gray and white matter. It must here be said that the minute histology has not been so carefully studied as to afford conclusive data.

Fig. H represents a longitudinal vertical section of the brain of *Amphiuma*, magnified four diameters, the shaded portions showing the gray or cellular matter. The vertical lines indicate, approximately, the position of twelve of the thirteen transverse sections which are figured. Fig. 9 passes through the anterior commissure and the forward portion of the diacœlia, not quite agreeing with any vertical line that could be drawn through fig. H. Much enlarged longitudinal and transverse views of the cerebellum are given in E and F. Fig. G gives an imperfect idea of some of the cells found in the crura.

The *Epencephalon* is the only division of the brain which has a complete investment of gray matter; this statement needs the reservation that the cells surrounding the cerebellum *may* be of epithelial origin, although this doubt is apparently disproved by the close similarity and continuity of their structure with those of the optic lobe. If this be admitted, the cerebellum is composed of three parts: (1) A continuous band of fibres arching from side to side of the medulla. (2) A fine layer of fibres which have an antero-posterior direction. (3) An investing layer of cells one or two rows deep. These parts are represented in fig. E, *b*, *a* and *c;* also in fig. F, *b* and *c*.

(1) The *transverse band* of fibres (fig. 1) form the greater part of the cerebellum; they appear to arise from columns of fibres in the lateral portions of the medulla, so that they correspond partially to the inferior peduncles of the mammalian cerebellum arising from the restiform bodies. (2) The fine layer of fibres have a direction at right-angles to these, and are three or four deep, seeming to terminate in the lateral portions of the cerebellum, in some cells lying between the cerebellum and the optic lobe. This layer, owing to the peculiar position of the cerebellum beneath the optic lobe, is dorsal to the main transverse band; if the cerebellum were turned backwards, this layer would be ventral to it. (3) The cells composing the cortex of the cerebellum are of an elongated-oval shape, usually one row, in some places two rows deep. Their greatest diameter is arranged parallel to the main band of transverse fibres. Here, as in other portions of the brain, it was difficult to ascertain whether or no these cells were continued into fibre processes. No such processes were discovered.

The above account differs widely from that given by Stieda[1] of the frog's cerebellum; although the latter is somewhat difficult to understand owing to the lack of figures.

The *Mesencephalon*. Posteriorly, the mesocœlia is broad and low, and the brain tube has a subpyramidal section; anteriorly, it becomes more circular and is surrounded by a shield-shaped mass of cells (figs. 2 and 3), surrounded in turn by the mass of longitudinal fibres, the whole constituting the optic lobe and crura. According to Stieda,[2] the brain of axolotl has a similar structure in this region.

The *Diencephalon* is the most interesting division of the brain; its deep but narrow cavity (diacœlia) is filled with the large choroid plexus; it has a very thin roof and floor, but broad lower sides. The *infundibulum* is formed by the thrusting downward of the posterior portion of the floor. Its walls are much convoluted; they are composed chiefly of white matter, with here and there a scattering of nerve-cells, which in some places form a continuous layer. The base of the infundibulum is closely reflected over the pituitary body as a thin lamina. The pituitary body has therefore no communication with the brain cavity, as has

[1] Zeitschrift für wiss. Zoologie, Band xx.
[2] Same Journal, Band xxv.

been observed in some animals. It is composed of a solid mass of granular cells, traversed by numerous blood-vessels, and resembles in structure, although more compact, one of the ordinary lymphatic glands.

The lumen of the infundibulum becomes narrower before it communicates with the diacœlia, and the lateral walls become thickened into two solid oval masses, largely composed of nerve-cells. These bodies resemble the *lobi inferiores* of the Teleosts, and, according to Stieda,[1] correspond in position with the tuber cinereum of the mammalia; anteriorly they gradually converge (figs. 4 and 5), finally entering the thalami. At this point the diacœlia has a cruciform shape, the lateral cavities separating the tuber cinereum from the walls of the Diencephalon above. In front of this is the thickening of the optic chiasma, and around the upper portion of the ventricle is a row of compact cells which resemble columnar epithelium. Anteriorly the latter flatten out, covering a lateral expansion of the ventricle. Above this is a small hollow sphere formed of a single layer of cells (fig. 7, *x*); the meaning of this structure is not known, and no mention of it has been found by the writer elsewhere. It corresponds in position with the external markings noticed upon the dorsal surface of the Menopoma brain at this point (see fig. C, *Di. t.*). Immediately below this point is a transverse band of nerve-fibres which probably belong to the optic chiasma.

The roof of the Diencephalon is of irregular thickness; forward it is carried as a very thin lamina over the *pineal gland.* The structure of this body is nothing more than a rich plexus of blood-vessels produced from the choroid; in the apex are numerous fine nuclei, resembling those of connective tissue, certainly not of nerve-tissue. There is no evidence that the latter is present.

It will thus be seen that the pineal body is a simple vascular structure, properly speaking, in communication with the brain cavity, since it is apparently surrounded by the brain parietes. The pituitary body, on the other hand, is a compact glandular structure, not in apparent communication with the brain cavity, except by an improbable process of osmosis through the attached cells.

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[1] Stud. über d. centrale Nervensystem d. Knochenfischer. Zeits. für wiss. Zoologie, Band xviii.

The sections are imperfect in the forward portion of the root of the Diencephalon (*diatela*); they do not show the *postcommissura*, described by Stieda and Wilder. The *præcommissura*[1] has its usual shape and position.

The relations of the Diencephalon to the *Prosencephalon* are shown in figs. 7, 8 and 9. The procœliæ extend back into the posterior sections of the hemispheres. Anterior to this the hemispheres fuse with the thalami below, receiving from the upper portion of the Diencephalon a conspicuous band of fibres (fig. 8, *a*). The relations of the dia- to the procœliæ are best obtained by means of horizontal longitudinal sections; these have not been made as yet, so that the nature of these cavities is somewhat doubtful. It appears that the procœliæ communicate with each other some distance anterior to the lamina terminalis.

The hemispheres have a great lateral extent, containing extensive cavities. Their posterior halves are partly fused together; anteriorly, however, they are quite separate and distinct, becoming more cylindrical in section in the region of the Rhinencephalon. A peculiar feature of each procœlia is the formation of a short superior median cornu (fig. 11, *a*); corresponding to this is an extension of the gray matter lining the cœlia to the cortex of the hemisphere. Forwards the cœliæ have a vertical and more internal position. The *Rhinencephala* arise in masses of gray cells in the anterior third of the lateral portions of the hemispheres; they do not contain any cavity, but are continued forward into the solid olfactory nerve.

The structure and distribution of the nerve-fibres and cells have not been closely studied; the following are some preliminary notes:

The cavities of the brain are throughout lined with masses of nerve-cells of varying thickness. Nerve-cells are also found scattered among the fibres, but these are somewhat rare. The gray substance lining the hemispheres corresponds to the *central gray*, the Höhlengrau of Meynert. At a few points it is found upon the brain cortex; these are: (1) the lateral bodies of the infundibulum (fig. 3); (2) the upper surface of the central portion of the hemispheres (fig. 11); (3) and the inner sides and front of the foremost portion of the same (fig. 12); (4) the cerebellum.

[1] Anterior and posterior commissures.

None of these cortical exposures of the central gray can be considered to correspond to the *cortical gray* (Rindengrau) of the mammalian brain. The gray substance is, therefore, chiefly central.

The scattered nerve-cells above referred to are principally found in the substance of the hemispheres above the cavities, internal to fig. 11, *a*. Here they are numerous.

The nerve-cells are chiefly small, oval and nucleated bodies, very compactly placed; among these at some points, as in the crura, much larger cells enveloped in loose capsules were discovered. No processes were found leading out of these cells, in fact no unmistakably branched cells were found at any point; this may have been the fault of the preparation methods, for Stieda has found that the branched nerve-cells are very numerous in the frog, while Wyman, employing simpler histological methods, failed to find them.

This is as far as the sections have been studied, although they offer very tempting opportunities for making out the nerve-tracts.

The following is a resumé of the results thus far obtained:

In external characters, *Amphiuma* differs widely from the frog type in the simpler differentiation of its parts, the mid-region of the brain being a rounded tube with no separation of its optic lobes and thalami indicated above. The cavities of the brain are equally simple, the meta-, meso- and diacœliæ forming a uniform cavity, forking into the procœliæ in front. The infundibulum has the large size which is so characteristic of it in the fishes, and its lateral bodies recall the *lobi inferiores* in the Teleosts, although passing forwards they form the tuber cinereum. The pineal and pituitary bodies are constructed upon clearly different principles, one being within, the other without the brain walls, the former a vascular plexus, the latter a gland. In the roof of the Diencephalon is a small spherical body whose meaning is not known, but which may prove to be of some morphological significance. The cerebellum has a cellular investment and consists of two sets of fibres with a transverse and fore and aft direction. The gray matter of the brain lines the cavities throughout, as the "central gray;" continuations of it extend in some places to the cortex, but the "cortical gray," if present at all, is very limited in distribution.

EXPLANATION OF PLATE VIII.

Illustrating the Brains of Amphiuma and Menopoma.

Lettering and Abbreviations.

Rh.—Rhinencephalon; *Pr.* and *Pro. c.*—Prosencephalon and Procœlia; *Di.*, *Di. t.* and *Di. c.*—Diencephalon, Diatela (roof of Diencephalon), and Diacœlia; *Me.* and *Me. c.*—Mesencephalon and Mesocœlia; *Ep.* and *Ep. c.*—Epencephalon and Epicœlia; *Met.*—Metencephalon.

Tc.—Tuber cinereum; *ch.*—optic chiasma; *pt.*—pituitary body; *pn.*—pineal gland; *in.*—infundibulum; *cho.*—choroid plexus; *cr.*—crura cerebri; *p. cm.*—præcommissura (anterior commissure); *th.*—optic thalamus.

I.—Optic; II.—Olfactory; III.—Oculo-Motor; V.—Trigeminis; VI.—Abducens; VII.—Facial; VIII.—Auditory; IX, X, XI.—Vagus Group. N. B.—The identification of the nerves was by noting their origin; the distribution of the nerves has not been worked out.

Special References in Figures.

Figures A-D, twice natural size. Figs. H and 1-18, eight times natural size.

Figure A. Dorsal view of the brain of *Amphiuma*.

Figure B. Ventral view of the same.

Figure C. Dorsal view of the brain of *Menopoma*.

Figure D. Lateral view of the same. Dit. corresponds to vertical line 7, fig. H.

Figure E. Enlarged view (about 30 diameters) of a longitudinal section of the cerebellum and a portion of the optic lobe, taken at one side of the median line. The valvula, *v*, is broader in the median line; *d*, white, *e*, gray portion of Mesencephalon; *a*, fine longitudinal fibres; *b*, transverse band of fibres; *c*, cortical layer of cells.

Figure F. Transverse section of the cerebellum, lettering as in fig. E.

Figure G. *a*, large, *b*, small cells found in crura cerebri (30 diameters).

Figure H. Longitudinal section of the brain of *Amphiuma*, taken to the left of the median line. Vertical lines, 1 to 13, correspond to transverse sections represented by figs. 1 to 13. Black line represents the pia mater; the roof of the metacœlia (fourth ventricle) is omitted in the drawing.

Figure 1. Vertical transverse section through cerebellum, showing it as a transverse band passing beneath Mesencephalon.

Figure 2. Ditto through pituitary body and infundibulum, showing crura cerebri and optic lobe unpaired.

Figure 3. Showing sides of infundibulum thickening into tuber cinereum.

Figure 4. Through posterior portion of the Diencephalon.

Figure 5. Through the median portion of the Diencephalon.

Figure 6. Slightly anterior to fig. 5. *y*, a constriction of the upper portion of the diacœlia.

FIGURE 7. Forward portion of Diencephalon. *y* corresponds to *y* in fig. 6; *x*, see *x* in fig. H.

FIGURE 8. Forward portion of Diencephalon. *a*, bands of fibres passing downwards into the hemispheres.

FIGURE 9. Forward lower portion of Diencephalon (*Di. c.*), showing præcommissura and procœlia.

FIGURE 10. Through the hemispheres slightly anterior to the lamina terminalis.

FIGURE 11. Median portion of hemispheres; *a*, gray matter extending to cortex.

FIGURE 12. Anterior third of hemispheres; showing the beginning of the Rhinencephalon.

FIGURE 13. Section near the tips of the hemispheres.

AUGUST 7.

Mr. CHARLES MORRIS in the chair.

Six persons present.

AUGUST 14.

Mr. CHARLES MORRIS in the chair.

Nine persons present.

AUGUST 21.

Mr. CHARLES MORRIS in the chair.

Six persons present.

AUGUST 28.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fifteen persons present.

Some Evidences of Great Modern Geological Changes in Alaska.—Mr. THOMAS MEEHAN exhibited a piece of wood taken from a prostrate tree, in what appeared to have been a sunken forest in Alaska. It was in Hood's Bay, as marked on some charts, on a peninsula formed by the junction of Glacier Bay and Lynn Channel, and facing Cross Sound, in lat. 58° 30′. The arboreal vegetation generally prevailing in this section consists of *Abies Sitkensis* (*A. Menziesii* of many botanists); *Abies Mertensiana*, the western hemlock spruce; and *Thuja gigantea*, called here "cedar" and "white cedar." *Thujopsis borealis* is said to "abound" in these districts by some anthors, but Mr. Meehan remarked that though looking for it through many hundred miles along the shores of the inland seas in southeastern Alaska, he did not see one specimen. The trees in the forest are of all ages, from young seedlings to aged decaying and dead ones. But in sailing into Hood's Bay he noted that the forests all had a comparatively young look—few of the trees appearing over fifty years old. The shores were high—at the point where he landed not less than fifty feet above tide-water—and the soil was sand, or of glacial production. Across from here to Lynn Channel the distance might be about twelve miles, and, so far as could be judged, the soil and trees across were of the same character; and

it appeared the same up and down the peninsula for miles. Along the shore he found numerous prostrate trees, and upright stumps which had been ground off a few feet above the surface. The stumps could be seen extending down below low-water mark, and they extended up to the bottom of the highland at high-water mark, where the mud in which they had grown was covered by the glacial deposit already referred to. The wood exhibited was part of one of these prostrate trunks, and is evidently the same species as that now existing on the land, *Abies Sitkensis*. It is quite sound, and exhibits no evidence of great age since it became covered with the drift. The shores are strewn with rocks and stones of various classes, as usual in cases of glacial deposits. On one of the prostrate trunks—the one from which the piece of wood exhibited was taken—there lies a block of granite which, by measurement, was found to contain 2214 cubic feet. This trunk was partially bent in the middle by the weight of the huge block of stone, showing that the block had fallen on it, while the ground beneath the trunk was comparatively soft. Near this, but so far as could be seen not on any trunk, was a much larger mass of granite, comprising 3888 cubic feet. The whole of the circumstances pointed to the almost certainty that there had been a sudden subsidence of the land, and that with the subsidence there was a flow of water with icebergs on which were these huge rocks, and which crushed the trees and tore off those which were strong enough to resist; and that subsequently to the destruction of the forest, the whole surface became covered to a great depth with drift. Since that time there must have been an elevation of the land, and the remains of the trees are again brought to their original surface, but with a deep bed of earth above them. Mr. Meehan believed that the botanical facts might afford a clue to an approximation to the time when these events occurred. The youth of the living forest indicated that, at the farthest, it could not have been more than a few hundred years since the elevation occurred. As already noted, the trees in the immediate vicinity appeared to be but about fifty years since germination; but unless the original parent trees which furnished the seed for the uplifted land were near by, it might take some years for the seed to scatter from bearing trees, grow to maturity, again seed, and in this way travel to where we now find them. But as original forests were evidently not so very far distant, two or three hundred years ought to cover all the time required. The Rev. Mr. Corlies, a missionary at Juneau, or Harrisburg as it is marked on some charts, informed the speaker that an Indian chief had told him that about seven or eight generations ago, as tradition told them, there had been a sudden and terrible flood in that land, and only a few Indians had escaped in a large canoe. The probable identity of the sunken trees with the present species, and the freshness of the wood, would indicate no very great date backwards at which the original subsidence occurred.

In connection with the subject of the comparative recentness of great geological changes as indicated by botanical evidence, Mr. Meehan referred to an exposure of the remains of a large forest near the Muir glacier, one of five huge ones which form the head of Glacier Bay, between lat. 59° and 60°. This glacier is at least two miles wide at the mouth, and has an average depth of ice at this spot of perhaps five hundred feet. At the present time there is not a vestige of arboreal vegetation to be seen anywhere, except some willows on the hillsides, some miles from huge hills of drift piled up everywhere around. The river which flows under the glacier, and which has a volume equal to the Schuylkill at Philadelphia, does not flow into the bay from under the ice at the face, but rushes out in a mighty torrent on the northwest side, a few miles above the mouth, and has cut its way through mountains of drift, the gorge being many hundred feet in width, and the sides from two hundred to five hundred feet high. The torrent through the bed is now comparatively level, carrying with it an immense quantity of heavy stones, some of which must have comprised masses of six or eight cubic feet. Along the sides of this gorge were the exposed trunks, all standing perfectly erect, and cut off at about the same level. Some were but a few feet high, and others as much as fifteen—the difference arising from the slope of the ground on which the trees grew. These trunks were of mature trees in the main, and were evidently of *Abies Sitkensis*, with a few of either *Thuja gigantea* or *Juniperus*, perhaps *Occidentalis*, the uncertainty arising from the imperfection of the bark—what there was of this indicating the former, while an eccentricity of outline of the wood, not uncommon in *Juniperus*, favoring the latter view. These trees must have been filled in tightly by drift to the height of fifteen feet before being cut off, or the trunks now standing would have been split down on the side opposite to that which received the blow, and the grinding off could not have been many years after, or the dead trees would have lost their bark, as they always do when under varying conditions of heat and moisture. The facts seemed to him to indicate that the many feet of drift which had buried part of the trees in the first instance was the work of a single season, and that the subsequent total destruction of every vestige of these great forests was the work of another one soon following. As in the case of the facts noted in Hood's Bay, Mr. Meehan believed that the conclusion was justified that the total destruction of the forests here, the covering of their site by hundreds of feet of drift, and the subsequent exposal to view of their remains, were all the work of but a very few hundred years.

Mr. Charles Peabody was elected a member.

SEPTEMBER 4.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Sixteen persons present.

The death of John C. Dawson, a member, was announced.

Exudation from Flowers in Relation to Honey-dew.—Mr. THOS. MEEHAN remarked that our standard literature yet continued to teach that the sweet varnish-like covering often found over every leaf on large trees, as well as on comparatively small bushes, was the work of insects, notably Aphides. So far as he knew, Dr. Hoffman, of Giessen, who in 1876 published a paper on the subject, is the only scientific man of note who takes ground against this view. He met with a camelia without blossoms, and wholly free from insects, and yet the leaves were coated with "honey-dew," as it is generally known. He found this substance to consist of a sticky colorless liquid, having a sweetish taste, and principally gum. Mr. Meehan said he had often met with cases where no insects could be found, as well as others where insects were numerous, and where in the latter case, the attending circumstances were strongly in favor of the conclusion that the liquid covering was the work of insects.

He said he believed that few scientific men had any knowledge of the enormous amount of liquid exuded by flowers at the time of opening, and he had seen cases where the leaves were as completely covered by the liquid from the flowers, as if it had exuded from the leaves, as he believed Dr. Hoffman had good grounds for believing is often the case. He had already brought to the attention of the Academy cases where large quantities of liquid had dropped from the flowers to the leaves below, of which *Yucca*, *Mahonia* and some others had been recorded in the Proceedings of the Academy. *Akebia* had been noted by Mr. Wm. M. Canby to drop from the leaves at certain times, and Sach notes in his Textbook the moisture which fills the small flowers of *Thuja*. In connection with the last case, the exudation from Coniferæ, he met with a remarkable case during his recent journey through the northwest coast. While collecting plants along the east shore of the Columbia River he noticed a plant of *Alnus Oregana*, covered with honey-dew. The woolly Aphis, so well known for its preference for alder, also abounded. Little drops of liquid were in many cases attached to the apex of the abdomen, and the conclusion was reached that in this case at least; the probabilities favored the insect origin of the liquid on the leaves. Proceeding a few feet further, towards the trunk of a large spreading Sitka spruce (*Abies Sitkensis*), and then on the other side, a bush of *Pyrus rivularis* was observed also covered, but not a sign of an insect

anywhere about it. This caused a reëxamination of the whole case, when it was noticed that stones under the spruce tree, forming the shore of the river, and many feet outside of the circle formed by the branches of the Pyrus and Alder, were quite black with a gummy coat, which most probably had fallen from the spruce, the branches of which overshadowed the two bushes already named, as well as the stones. The branches of the spruce hanging towards the river were covered with young cones of probably one-half their full size, and the scales were found to be filled with sweet liquid. Taking the cone as it hung on the tree and stripping it down as one would milk a cow, a drop as large as a pea gathered in the hand from a single cone. There could be no doubt but that the viscid covering on the leaves of the two shrubs below, as well as on the unprotected stones, came from the cones of the spruce tree. He had seen, two years ago, the glossy covering over the leaves of the *Liriodendron* at flowering time, and found the opening flowers with a large quantity of liquid at the base, and had intended especially to give the matter minute attention the past summer and then report to the Academy; but his long journey had diverted him. Recently the subject had been again brought to his attention during some experiments in relation to pollinization and cross-fertilization in *Platycodon grandiflora* not yet concluded. Cutting open very carefully a corolla just about to expand, the whole inner surface was found to be coated with minute drops of moisture, which, as they gathered in size, streamed down toward the base of the pistil. This liquid was not sweet, but had the taste of lettuce. In the case of the moisture which exuded from the divisions of the perianth in *Yucca gloriosa* and *Yucca angustifolia* before reported, the taste was rather bitter than sweet. He said there was reason for the belief that much of the moisture found at the base of flowers was not the product of "nectariferous glands," which were sometimes guessed at rather than always detected, but was rather the collection from exudation from the petals; and if so it was a confirmation of Dr. Hoffman's idea of the origin of honey-dew through the surface of the leaf, as we might reasonably suppose a modified leaf like the petal of a flower to have some functions in common with the primary leaves from which they sprung.

What is the object of this abundant exudation of sweet liquid and liquid of other character from leaves and flowers? The speaker said we were so accustomed to read of nectar and nectaries in connection with the cross-fertilization of flowers, that there might seem to be no room for any other suggestion. But plants like the *Thuja* and *Abies* were anemophilous, and having their pollen carried freely by the wind, had no need of these extraordinary exudations from any point of view connected with the visits of insects to flowers. In the case of *Thuja*, Sach had suggested another use: "The pollen-grains which happen to fall on the micropyle of the ovules are retained by an exuding drop of fluid,

which about this time fills the canal of the micropyle, but afterwards dries up, and thus draws the captured pollen-grains to the nucleus, where they immediately emit their pollen-tubes into the spongy tissue. In *Cupressineæ*, *Taxineæ* and *Podocarpeæ* this contrivance is sufficient, since the mycropyles project outwardly; in the *Abietineæ*, where they are more concealed among the scales and bracts, these themselves form, at the time of pollination, canals and channels for this purpose, through which the pollen-grains arrive at the micropyles filled with fluid" (STRASBERGER).[1] Mr. Meehan said that in his former observations on liquid exudations in *Thuja* and other plants he was inclined to adopt the suggestion of Sach as to the purpose of the liquid supply; but as it was here in *Abies* so long after fertilization must have taken place, and as it was held up in the deep recesses of the scales of the pendent cone, where it could hardly be possible the wind could draw up the pollen; and as, moreover, the extract shows that these eminent botanists believe *Abietineæ* does not need the moisture they did not know existed in this abundance, we must look for other reasons, which, however, do not yet seem to be apparent.

SEPTEMBER 11.

Mr. MEEHAN, Vice-President, in the chair.

Sixteen persons present.

The death of the Curator-in-charge, Charles F. Parker, on the 7th inst., was announced.

Irritability in the Flowers of Centaureas and Thistles.—Mr. THOMAS MEEHAN called attention to some flowers of various compositæ on the table, sent by Miss Mary E. Powel, of Newport, Rhode Island, who has observed a singular motion in the florets of *Centaurea Americana.* This motion had long been known to German botanists, and a reference to some features of it may be found in Sach's Text-book of Botany, and there was an illustrated paper by Cohn in *Zeitschrift für wis. Zoologie*, vol. xii, showing the mechanism of the contraction of the anthers. As, however, the motion had failed to attract the attention of American observers, or at least he knew of no reference to it in any American work at his command, he believed it might do good service to place on record an independent statement of the phenomena as exhibited by the specimens before us.

Besides the motion in *Centaurea Americana*, observed by Miss Powel, Mr. Meehan said that he found a similar motion in the following plants growing in his garden: *Centaurea alba*, *Centaurea*

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[1] Sach, Text-book of Botany, Oxford edition, p. 449. The various ways of spelling micropyle in the same paragraph, are of course retained in the quotation.

nigra, *C. ochroleuca*, *C. rutifolia*, *Cirsium serrulatum*, *C. discolor*, and *C. lanceolatum*. The motion seems most active when the anthers are ready to shed their pollen, and, as pollen-gathering insects anticipate the observer, it is best to cut the flowers and place them in water in a room. Endeavoring to observe the motion of *Cirsium discolor* in the growing plant almost failed from this cause, but on drawing a light substance over the whole head, some of the florets were found to move.

In the *Centaurea* flowers on the table, the best period for observing the motion is when the anthers which cover the apex of the pistil seem about to allow the pistil to protrude. If then touched, the pollen is seen to issue from the mouth of the united stamens, and the whole crown of anthers to decline. Cohn, above cited, gives the exact measurement of this contraction, and explains the mechanism by which the contraction is accomplished. At the same time, if the motive power be very active, the whole upper portion of the floret, moves in some direction, apparently without order or system. Sometimes it is in a lateral direction, at other times upwards or downwards, and sometimes describing a circle round its own axis. In some cases the motion is communicated to other florets—two and sometimes three moving to the touch of a single one. In ten minutes after the exhibition of irritation, it is ready for another fit, and goes through the motions, though less actively than before. Mr. Meehan had failed to get any motion three times from the same floret, and not always two. Touching the pistil had no effect unless the force was sufficient to press one side against the anther. The irritation seemed to be confined to the stamens, and through these probably down by their nervous connections through the achenium, and in this way communicating with the nerves which run up through neighboring achenes to the stamens which they support.

Since the above communication was made to the Academy, Mr. J. H. Redfield believes that the neutral ray florets in *Centaurea Americana*, which have neither stamens nor pistil, also possess the power of motion, and Miss Powell, without knowledge of Mr. Redfield's observation, notes a similar experience.

SEPTEMBER 18.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Thirty-one persons present.

The death of John C. Trautwine, a member, was announced.

Notes on the Sequoia gigantea.—Mr. MEEHAN remarked that so much had been written about the mammoth trees, that there seemed little room for more; but to one of the fullest accounts given, namely, that by Mr. Muir in the Proceedings of the Meeting of

the American Association for the Advancement of Science, at Buffalo, 1876, he believed he might add a few additional facts, drawn from or suggested by a visit made to a few of the groves during the past summer. He could confirm the statement of Mr. Muir that there were comparatively few young plants growing among the old ones in the Calaveras or Mariposa groves. In the latter spot a few might be found in swampy places. Many of the large trees were also growing in swampy ground, while some were found where the ground would be pronounced quite dry. Mr. Muir gave 5000 feet as about the elevation of the trees in these—the northern part of the belt occupied by them. On the southern part of the belt Mr. Muir found them at about 8000 feet, and there numerous young trees formed the great mass of the undergrowth, and furnished an abundance for a perfect succession of forest trees. Here Mr. Muir found them in ground not swampy, as well as in situations as swampy as possible, and he concludes that the *Sequoia gigantea* is a tree which has the power of growing in dryer and wetter soil than most other species. He adds: "It is constantly asserted in a vague way, that the Sierra (in past times) was vastly wetter than now, and that the increasing drouth will of itself extinguish *Sequoia*, leaving its ground to other trees supposed capable of flourishing in a dryer climate. But that *Sequoia* can and does grow on as dry ground as any of its present rivals, is manifest in a thousand places. 'Why, then,' it will be asked, 'is *Sequoia* always found in greatest abundance in well-watered places where streams are exceptionally abundant?' Simply because a growth of sequoias always creates these streams. * * * Drain the water, if possible, and the trees will remain; but cut off the trees, and the streams will vanish." He has seen a fallen trunk make a dam of 200 feet long, and similar bogs made by roots and fallen trunks damming the earth, are familiar features in the more luxuriant sequoia forests. On this bare suggestion Mr. Muir builds as if it were a demonstration, and proceeds to say: "Since the extra moisture found in connection with the denser growths is an effect of their presence, instead of a cause of their presence, then notions, * * * based upon its supposed dependence on greater moisture, are shown to be erroneous."

In the light of these views, Mr. Meehan said he had carefully examined the trees in the groups scattered from the Fresno to Calaveras, and could say that in these localities the sequoias possessed no more power of making the ground swampy than any other tree which might form the leading forests in heavy wooded districts. The huge specimens of *Pinus Lambertiana*, *Pinus ponderosa*, and the thick groves of *Libocedrus*—huge, though averaging at best but two-thirds the diameter of the mammoth sequoias—did not make the ground swampy in the slightest degree. Mr. Muir's supposition—for it surely cannot be regarded as such a demonstration as science requires—would give us small swamps, at least, for the smaller trees.

Experience of forest growths in the eastern states gave abundance of facts, which were quite sufficient to explain the existing state of things, on grounds very different from those assumed by Mr. Muir. Observers knew that there were trees which loved moisture, and trees which preferred dry ground. Swamp-lovers would grow in dry places almost as well as in wet ones, but the dry-lovers would not grow in wet places. The swamp magnolia, swamp willow, swamp azalea, the bald cypress, the swamp maple, the sweet gum—every swamp tree that can be named—do just as well, and in many cases better, in dry ground. This is so well known to every intelligent cultivator of trees, that its correctness is beyond dispute. Here in the east, the largest red maples, willows, cypresses, and other swamp trees, are the occasional specimens which by accident find themselves on dry ground. On the other hand, the dry-land species of pine, oak, maple, and other trees, can under no circumstances be made to grow in wet places; and, therefore, if Mr. Muir's suggestion that the *Sequoia* was once a dry-land plant, and made the land swampy through its own growth, should by any possibility be found correct, it would probably be an exceptional case in the vegetable kingdom. It had been shown by himself, the speaker said, in past communications to the Academy, printed in its Proceedings, that trees only grow in swamps from a provision of nature that their seeds shall only germinate in wet places. It seems like a determination of nature that some trees shall grow in swamps, whether they prefer it or not. Though these trees grow better and fruit freely in dry ground, the trees cannot spread, because there is not the moisture required for the seed to grow.

Mr. Muir mistakes the argument. It is not that sequoias will not grow in dry ground, but that the seed will not germinate to any extent except under highly humid conditions. Ground need not be absolutely wet. The cultivator raises swamp ferns on bricks, and the swamp rhododendron is often found on rocky ledges, but this is only where a humid atmosphere keeps the seed from drying till it grows. The atmospheric humidity at 8000 feet would be more likely to help *Sequoia* at 8000 feet than at 5000. In concluding this branch of the topic he said the facts spoke for themselves. The seed did not grow now—there were no seedlings—though seeds were abundant. They grew in former times or the trees would not exist. There must be some change in the conditions necessary to make seeds grow since the forest was started. We know from outside observations that seed of swamp-loving trees will not grow under arid conditions. We see that the *Sequoia* is a swamp-lover. Is not this getting to as close an explanation as science rarely reaches? May we not say that *Sequoia* does not spread because the humid conditions are not as they once were when the forests were founded? This was certainly his conclusion from the facts as they presented themselves to his observation.

If this be incontrovertible, it opens up an interesting question as to the cause of the desiccation in the vicinity of the big trees. The ratio of disintegration in a mountain peak, by the frost, rains, and elements generally, and the descent of the loose mass to the lower lands by the simple law of gravity alone, would depend on the width of the peak, as well as the nature of the material. In the process of ages, peaks covered with snow would be lowered till they were no longer snow-capped in summer, and thus lower regions in the vicinity, covered perchance with *Sequoia*, would be under dryer atmospheric conditions. To a greater or less extent this must be the case in all mountain changes, but whether this could have been going on to any appreciable extent in the few thousand years during which these trees have occupied the spot, is a question for geologists to determine. However, Mr. Muir himself gives good reasons for the belief that these trees followed from the west, eastwardly, in the close wake of retreating glaciers, and when the atmospheric moisture, as well as that of the earth contiguous, must have been more moist than now.

In regard to the age of the trees, Mr. Meehan said doubts had been expressed whether the *Sequoia* might not make more than one annual circle of wood a year, and thus render the count by these annual circles unsafe. He had given close attention to this point on the ground, by measuring the height of thrifty young trees, and estimating by the growth per year the probable age. A tree of say thirty, forty or fifty feet, would be seen to be about that many years old. The diameter of the trunk would then be taken and found to correspond with the one annual ring per year in the sections of the larger trees, as per actual count. There would be no question but the larger trees were over 2000 years old.

He found that when about three or four hundred years old, the trees ceased to increase in height to any appreciable degree, the effort of the tree being more in a lateral direction, and the nutritient matter necessary to the building up of the trunk was mainly the work of the side branches. The height of one called "Haverford," after our sister college, he found, by a rough triangulation, to be about 249 feet.

SEPTEMBER 25.

Rev. Dr. H. C. McCook, Vice-President, in the chair.

Thirty-seven persons present.

The death of Alexis T. Cope, a member, was announced.

Restoration of Limbs in Tarantula.—Rev. Dr. McCook remarked that the tarantula exhibited had been kept in confinement nearly a year, fed during winter on raw beef and in summer on grasshoppers. In the spring it cast its skin, by a laborious

process, which was described to the Academy, in the course of which it lost one foot and two entire legs. This summer again, during the latter part of August, the animal moulted; the moult as exhibited is a perfect cast of the large spider—skin, spines, claws, the most delicate hairs all showing, and their corresponding originals appearing bright and clean upon the spider. The moulting occurred during Dr. McCook's absence, but was just finished when he returned. When the cast-off skin was removed it showed, as might be supposed, the dissevered members to be lacking. But on looking at the spider itself, it was seen that new limbs had appeared, perfect in shape but somewhat smaller than the corresponding ones on the opposite side of the body. The dissevered foot was also restored. The loss of the opportunity to see the manner in which the legs were restored during moult was greatly regretted; but we have some clue from the careful and interesting studies of Mr. Blackwall. Several spiders whose members had been previously amputated, were killed and dissected immediately before moulting. In one of these the leg which was reproduced was found to have its tarsal and metatarsal joints folded in the undetached half of the integument of the old tibia. Another like experiment was made with an example of *Tegenaria civilis*. The reproduced leg was found complete in its organization, although an inch in length, and was curiously folded in the integument of the old coxa, which measured only one-twenty-fourth of an inch in length. Dr. McCook's tarantula had lost both legs close up to the coxæ, and in the moult the hard skin formed upon the amputated trunks was wholly unbroken, showing that the skin had been cast before the new leg appeared. We risk nothing in inferring that, as in the case of Blackwall's *Tegenaria*, the rudimentary legs were folded up within the coxæ, and appeared at once after the moulting, rapidly filling out in a manner somewhat analogous to the expansion of the wings in insects after emerging.

Messrs. Henry F. Claghorn and Emanuele Fronani were elected members.

OCTOBER 2.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Twenty-eight persons present.

The death of Charles Magarge, a member, was announced.

The Synchronism of Geological Formations.—Professor ANGELO HEILPRIN, referring to one of the many vexed problems which from time to time engross the attention of geologists and naturalists, namely, the contemporaneity of geological formations, stated that the order of deposit of the various formations, from the oldest to the newest, was constant the world over, and that nowhere, except

where there may have been a reversal of the strata themselves, was there evidence of a reversed position. Corresponding strata, as indicated by the contained fossils, had therefore been supposed to belong to the same age, although occurring in widely separated regions. This view, for a long time maintained undisturbed by the earlier geologists and palæontologists, had, however, been dissented from by Edward Forbes, Huxley, and other advocates of the doctrine of faunal dispersion from localized areas or centres of distribution (opponents of independent creation), on the obvious ground, that faunas starting from a given point of origination could only spread by migration, and that such migration must consume time, proportional to the distance traveled and the physical and physiographical facilities afforded for traveling. Hence it was argued that widely separated formations showing an equivalent faunal facies, as, for example, the Silurian of America and the Silurian of Europe or eastern Asia, or the Cretaceous of Europe and South America, could not be of identical age, and, with a fair show of probability, not even approximately so. In support of this position it has been urged that during the present age of the world the faunas of the several continents are widely distinct, and could, under geological conditions, be considered as indicating different zoological (geological) eras. In conformity with this view, Professor Huxley had proposed (Anniversary Address, Geol. Soc., 1862. Q. J. Geol. Soc., xviii, p. xlvi) the term "homotaxis," indicating similarity of arrangement, in place of synchrony, to describe the relations of distant areas of the same formation.

Pushing his conclusion to what appeared to be its furthest legitimate point, Professor Huxley deduced therefrom two important considerations:

I. That formations exhibiting the same faunal facies may belong to two or more very distinct periods of the geological scale as now recognized; and conversely, formations whose faunal elements are quite distinct, may be absolutely contemporaneous; *e. g.:* "For anything that geology or palæontology is able to show to the contrary, a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa" (*loc. cit.*).

II. That, granting this disparity of age between closely related faunas, all evidence as to the uniformity of physical conditions over the surface of the earth during the same geological period (*i. e.*, the periods of the geological scale), as would appear to be indicated by the similarity of the fossil remains belonging to that period, falls to the ground. "Geographical provinces and zones may have been as distinctly marked in the Palæozoic epoch as at present, and those seemingly sudden appearances of new genera and species, which we ascribe to new creation, may be simple results of migration."

These views, enunciated by Prof. Huxley, were still largely

held, Prof. Heilprin maintained, by a very large body of geologists. But it can readily be shown by a logical deduction that at least one of the conclusions arrived at (I) is, in almost certainty, erroneous; and that the second, based upon this one, derives no confirmation from the supposed facts. If, as is contended, several distinct faunas—*i. e.*, faunas characteristic of distinct geological epochs—may have existed contemporaneously, then evidences of inversion in the order of deposit ought to be common, or, at any rate, they ought to be indicated somewhere, since it can scarcely be conceived that animals everywhere would have observed the same order or direction in their migrations. Given the possible equivalency in age, as claimed, of the Silurian fauna of North America with the Devonian of the British Isles and the Carboniferous of Africa, or any similar arrangement, why has it never happened that when migration, necessitated by alterations in the physical conditions of the environs, commenced, a fauna with an earlier facies has been imposed upon a later one, as the Devonian of Great Britain upon the Carboniferous of Africa, or the American Silurian upon the Devonian of Britain? Or for that matter, the American Silurian may have just as well been made to succeed the African Carboniferous. Why has it just so happened that a fauna characteristic of a given period has *invariably* succeeded one which, when the two are in superposition, all over the world (as far as we are aware), indicates precedence in creation or origination, and *never* one that can be shown to be of later birth? Surely these peculiar circumstances cannot be accounted for on the doctrine of a fortuitous migration. Nor can it be claimed that, through the interaction of the evolutionary forces, a migrating fauna with an early-life facies will in each case at the point of its arrest have assumed the character of the later-day fauna which belongs to that position. Therefore it appears inexplicable that a very great period of time could have intervened between the deposition of the fauna of one great geological epoch at one locality, and that of the same or similar fauna at another locality distantly removed from the first. In other words, the migrations, for such must undoubtedly have been the means of the distant propagation of identical or very closely related life-forms (unless we admit the seemingly untenable hypothesis that equivalent life-forms may have been *very* largely developed from independent and very dissimilar lines of ancestry), must have been much more rapidly performed than has generally been admitted by naturalists. (*Sic* Huxley: "All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question, Were the British Cretaceous rocks deposited at the same time as those of India, or are they a million of years younger or a million of years older?")

But what applies to the broader divisions of the geological scale also applies to the minor divisions. Thus the subordinate

groups of a formation are almost as definitely marked off in the same order, the world over, as are the formations themselves. After breaks in formations the appearance of characteristic fossils is largely the same; whereas, on the theory of synchronism of distinct faunas, such a succession of forms would certainly not be constant. After deducing further evidence from the lithological characters of the rock-masses of the various geological formations, the speaker maintained that the views entertained on the subject by the older geologists were more probably the correct ones, namely: that formations characterized by the same or very nearly related faunas in widely separated regions belonged, in very moderate limits, to approximately the same actual age, and were, to all intents and purposes, synchronous or contemporaneous.

Longevity of Trees.—At the meeting of the Botanical Section, October 8, Mr. THOMAS MEEHAN remarked that there was nothing phenomenal in the great age of the mammoth sequoias, as other trees on the Pacific coast exhibited great age. In order to ascertain whether more than one annual circle of wood is formed in each year, he tested the matter in various ways. For instance, a pine or spruce would be found to make an average growth of a foot a year up to fifteen years old; from that to about thirty years, nine inches; from that on, six inches; after that a stage was reached where the erect growth ceased to any considerable extent, and the growth force seemed turned toward the lateral branches. In the pine forests of the Pacific coast, there was no danger of error in fixing the age of the average tree of sixty feet high, at about fifty years. Wherever such a tree was cut down, and an opportunity afforded to count the circles, they would be found to correspond so nearly with the calculated age, as to prove that it was quite safe to assume a single circle for a single year. Then there was a remarkable degree of uniformity in the diameter of these annual growths in most trees, so that when once we had the number of the circular lines to an inch, and the diameter of the tree, we could tell its age near enough for general purposes. In some pine trees growing on very rich soil, he had found as few as about four circles to an inch. For instance, a section of a *Pinus Lambertiana* (in Mariposa), four feet across, had but 189 circles; but here the increased size of the trees corresponds with the larger annual circles. Trees of this species of pine here were not uncommon, measuring thirty, and a few thirty-three feet around. No matter, however, how vigorous may be the growth of trees under fifty or one hundred years, they decrease with age, and we may safely allow six rings to an inch in these older sugar pines, which would make the thirty-three feet tree 396 years old. The outer growths of sequoia were very narrow. He counted as many as eighteen to the inch, while the rings in the interior of cross-sections would show about six to the inch. Allowing twelve as

the average per annum, a tree of thirty-three feet diameter would give 2376 years old, which is about the same as given by an actual count of rings. At Harrisburg or Juneau, in lat. 58°, a Sitka spruce (*Abies Sitkensis*) cut down, gave 149 rings from centre to circumference—298 lines, in a trunk three feet across. This gave an average of about eight to an inch in this 149 years old, three feet tree. At Wrangel, lat. 56°30′, a tree of the western hemlock (*Abies Mertensiana*) which had been blown down, and afterwards divided by a cross-cut saw at four feet from its base, gave eighteen lines to an inch, and the annual growths seemed very regular almost to the centre of the tree. It was six feet in diameter, and must have been a grand old tree in its day. It had evidently been broken off years before it was blown down, but the length of this trunk up to where it had been broken was 132 feet, and four feet in diameter at that height. But allowing as much as twelve to an inch, it would give for the point cut across, six feet, an age of 432 years. At Kaigan Harbor, lat. 55°, the Sitka spruces were very large, and of great height. He measured two of the largest, which were twenty-one feet in circumference each. Allowing eight to the inch, as in the tree of the same species at Harrisburg, it gives 336 years as the age of the tree; so far as appearances went, these trees were in the height of vigor, and there seemed no reason, judging from experience in other cases, why these trees might not flourish for a hundred years yet. Mr. Meehan had no doubt that these trees in these latitudes in Alaska, would easily have a life of 500 years.

Turning now to the Atlantic States, we find 200 years as the full average term of life for its forest trees, with the exception, perhaps, of the plane, *Platanus occidentalis*, which is the longest lived of all. Trees famous for longevity in Europe are comparatively short-lived here. In the old Bartram Garden, near Philadelphia, where the trees can be little more than 150 years old, nearly all are past their best. The English oak, *Quercus Robur*, which in England is said to live for a thousand years, has grown to full size and wholly died away in this garden, and the foreign spruces are on the down grade. The great cypress, *Taxodium distichum*, which must have made an average growth of four lines a year, has also begun to show signs of deterioration. Silver firs, *Abies pectinata*, in the vicinity of Philadelphia, known to be planted in 1800, are decaying. This is the general experience.

In seeking for the cause of this difference, we are accustomed to look at the relative humidity of the atmospheres of Great Britain and the Atlantic United States. Evergreens like *Cerasus Laurocerasus*, *Laurus nobilis*, and *Viburnum tinus*, which will endure a temperature of 25° below freezing point in Great Britain, are killed by 10° in Philadelphia; and it is believed by the dryer atmosphere causing a heavier drain for moisture on the vital powers of the plant to supply. A strain which will

wholly destroy plants in some instances, must have an enervating influence where it does not wholly destroy, and this would naturally be exhibited in shortening the life of the tree.

The climate of Alaska had the same favoring influences we found in Great Britain. The warm sea of Japan flowed against its southeastern face, along which the trees referred to were found. The atmosphere was always moist, and severe weather almost unknown. At Sitka, in lat. 57°, as much as 100 inches of rain had fallen in a single year. The harbor was rarely frozen; boats came in and went out at all times of the year. There were some winters when no ice of any consequence was seen. These were circumstances favorable to longevity in trees.

Mr. Meehan concluded by remarking that Dr. Lindley had said somewhere that his researches had failed to show that there was any period of duration of life set for any tree, and that if circumstances favored there seemed no reason why trees might not live for an indefinite period, and, therefore, arguments offered in connection with the "wearing out of varieties," based on what is called the "natural life of a tree," had little force. Mr. Meehan believed his observations on the longevity of trees on the Pacific confirmed Dr. Lindley's views. At any rate, there seemed nothing phenomenal in the age of the *Sequoia gigantea*, as other species partook of similar longevity to a great extent.

Prof. Angelo Heilprin was elected Curator, to fill the vacancy caused by the death of Charles F. Parker.

OCTOBER 9.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

The Council reported the appointment of Prof. Angelo Heilprin as Actuary to the Curators, or Curator-in-charge.

Mineralogical Notes.—Dr. LEIDY exhibited a large crystal of topaz, from Mursinsk, Siberia. It is pale blue, with perfect termination, and weighs three pounds three ounces. He also exhibited large cut specimens of white topaz and rich green beryl, which had met with a curious accident. The two, in unpacking, had been violently struck together, and the former had been broken through the middle so as to exhibit a perfect cleavage.

OCTOBER 16.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Thirty-seven persons present.

OCTOBER 23.

Mr. CHARLES MORRIS in the chair.

Six persons present.

The deaths of Joachim Barrande, Oswald Heer and W. Kowalewsky, correspondents, were announced.

OCTOBER 30.

The President, Dr. LEIDY, in the chair.

Forty-five persons present.

The following were presented for publication:

"Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences of Philadelphia, from January 23, 1882, to November 26, 1883."

"On the Anatomy of Ancylus lacustris and Ancylus fluviatilis," by Dr. Benj. Sharp.

"Note on a Collection of Fossils from the Hamilton (Devonian) Group, of Pike Co., Pa.," by Prof. Angelo Heilprin.

"Manayunkia speciosa," by Prof. Jos. Leidy.

"On the Evidences of Glacial Action in Northern New York and Canada," by Jos. Willcox.

"Obituary Notice of Charles F. Parker," by Isaac C. Martindale.

The death of J. Lawrence Smith, a correspondent, was announced.

Francis A. Cunningham and S. Mason McCollin, M. D., were elected members.

Eugene A. Rau, of Bethlehem, Pa., was elected a correspondent.

The following were ordered to be published:

MANAYUNKIA SPECIOSA.

BY PROF. JOS. LEIDY.

At the time of the discovery of the pretty polyzoan, *Urnatella gracilis*, of which a description is now in course of publication in the Journal of the Academy, I found an equally interesting little annelide, of which I gave a brief notice in 1858, published in the Proceedings for that year, page 90, under the name of *Manayunkia speciosa*. The two were found in company together, attached to the same stones, in the Schuylkill River, at Fairmount, Philadelphia. They seem fitting associates, for while *Urnatella* is nearly related with the marine *Pedicellina*, *Manayunkia* is closely related with the marine annelide *Fabricia*. *Manayunkia* has proved to be less frequent than *Urnatella*, nor have I found it elsewhere than in the locality named. Recently, several specimens were submitted to my examination by our fellow-member, Mr. Edward Potts, who found them attached to a fragment of pine-bark, in Egg Harbor River, New Jersey. Independent of the interest of finding the worm in a new locality, the specimens have enabled me to complete an investigation of the animal so far as to prepare the following description, though I have to regret that the material has been insufficient to allow me to clear up several important points. I have had the opportunity of comparing *Manayunkia* with a species of *Fabricia* living on our coast, and have found the two to be so nearly alike, that I am prepared to hear it questioned whether the former should be regarded as generically distinct from the latter.

Manayunkia forms a tube of mud, which it occupies. The tube is composed of the finest particles, aglutinated by a mucoid secretion of the worm. It is cylindrical, straight or bent, mostly even or slightly uneven on the outside, and sometimes feebly annulated. It is attached partly along its length to fixed objects, with the greater part free, directed downward and pendant. Most specimens observed were single, but several were found in which two or three tubes were conjoined, and in one instance five tubes with remains of others were given off, in a candelabra-like manner, from a common stem, as represented in fig. 2, Plate IX. From the open mouth of the tube, the worm protrudes its head and spreads its crown of ciliated tentacles, in the same manner as in

most tubicolous annelides. The simple tubes range from two to four lines in length by the one-fifth to the one-fourth of a line in width.

Manayunkia is very sensitive, and on disturbance withdraws deeply into its tube, so that half the length of the latter may be removed before reaching the worm. The little creature clings tightly to the inside of its habitation, apparently mainly by means of the minute podal hooks of the posterior segments of the body.

The mature worm (fig. 1) is from three to four millimetres in length by about one-fourth of a millimetre in breadth, and is divided into twelve segments, including the head. The color is translucent olive-green, with the cephalic tentacles of a slightly brownish hue. As the worm shortens, the segments become more bulging laterally and the constrictions deeper; in elongation, the segments become more cylindrical and the constrictions less marked. When the worm is elongated, it is of nearly uniform width for about three-fourths of the length, and then slightly tapers to the end, or is a little widened again in the two segments before the last. The head is about as broad as it is long, and is surmounted by a pair of lateral lophophores supporting the tentacles. Its border above projects dorsally into a short rounded process. The succeeding four segments of the body are about as broad as they are long, and nearly of uniform size; the next one is somewhat longer than those in advance. The seventh segment, in all the mature worms observed, greatly exceeded any of the others. It was usually twice the length, and differed from them in having an abrupt expansion at the fore-part, which suggested the production of a head prior to division of the worm; a process, however, if it occurs in *Manayunkia*, I had not the opportunity of observing. The succeeding segments, smaller than the anterior ones, differ little in size, except the last two. The terminal segment abruptly tapers from above its middle in an obtusely rounded extremity. When the worm protrudes from its tube, the lophophores are reflected from the head, and they exhibit a double row of tentacles extending forward. The number of tentacles varies with the age of the worm, but at maturity there are usually eighteen for each lophophore. They are of moderate length, and of uniform extent, and measure about half a millimetre. Two of them internally, one for each lophophore,

are rather longer and larger than the others, and are rendered conspicuous by a large vessel filled with bright green blood. The tentacles are invested with ciliated epithelium, with actively moving cilia, and in all respects bear a close resemblance to those of the polyzoa. In the allies of *Manayunkia*, they are regarded as branchial appendages, and usually named cirri; and although this is unquestionably correct, as in the case of the corresponding organs of the polyzoa, they perform a varied function, and may, with equal correctness, be called tentacles.

When *Manayunkia* is about to withdraw into its tube, the lophophores approach, and together with the tentacles form a close longitudinal fascicle. Along the lophophores, at the base of the tentacles, there is a row of half a dozen or more brownish pigment spots, resembling eyes, but not having the usual constitution of such organs. The segments of the body of *Manayunkia*, succeeding the head, are furnished on each side with a fascicle of locomotive setæ, which is divided into two portions, one usually consisting of shorter setæ than the other. The fascicles, when most protruded, project from a papilla, which disappears with the partial retraction of the former. They are projected directly outward or in a slanting manner either forward or backward, and are moved in the same manner and by the same arrangement of muscles as in other chætopods. The number of podal setæ is from four to ten in each fascicle. In several mature individuals the numbers in the different segments were as follows: 8 to 10 setæ in the first to the sixth segment; 6 to 7 in the three succeeding ones; 4 or 5 in the tenth, and 3 or 4 in the last segment.

The setæ, figs. 3, 4, of the anterior segments are longest, and range from about 0·15 to 0·25 mm. in length. They consist of a long, straight rod, with a linear-lanceolate blade tapering into a long filament. The rod varies little in length in the different setæ; but the blade varies considerably in this respect. The blade is more or less bent from the rod, and is longest in the longer setæ.

Except the head and the first setigerous segments, the others are provided on each side with a fascicle of podal hooks, which are situated ventrally behind the bottom of the podal setæ. The hooks are 4 or 5 in each fascicle in the setigerous segments from the second to the eighth inclusive, and are very different from those of the succeeding segments. The podal hooks, fig. 5, of the

anterior segments, are about 0·05 to 0·06 mm. long, and consist of a long curved handle, ending in a small recurved hook.

The podal hooks of the posterior three setigerous segments form close transverse rows, fig. 6, of variable number, from 9 to 24 in each row. The hooks are minute, and measure from 0·025 0·03 mm. long. They consist of a broad handle, ending in a lateral comb-like extremity, as represented in figure 7.

The number of podal setæ and podal hooks is more or less variable in the corresponding segments of different individuals, and frequently also on the two sides of the segments of the same individual. The difference is due sometimes to the accidental loss of some of the appendages; sometimes probably to circumstances interfering with their development. In several specimens the following differences were observed:

SPECIMEN 1.

First segment, 6 and 8 setæ.

Second to fourth segment, inclusive, 8 to 10 setæ and 4 to 5 hooks.

Fifth to eighth segment, inclusive, 6 to 8 setæ and 4 to 5 hooks.

Ninth segment, 6 setæ and 9 and 22 hooks.

Tenth segment, 4 setæ and 12 and 18 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 2.

First segment, 8 setæ on each side.

Second to sixth segment, inclusive, 8 setæ and 4 hooks on each side.

Seventh and eighth segments, 6 or 7 setæ and 4 hooks, except on one side of the eighth segment, in which another fascicle of 6 setæ substituted the usual fascicle of hooks.

Ninth segment, 6 setæ on each side and 9 and 20 hooks.

Tenth segment, 4 and 5 setæ and 13 and 16 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 3.

First segment, 8 setæ each side.

Seven succeeding segments, 6 to 10 setæ and 3 to 4 hooks each side.

Ninth segment, 7 setæ and 24 hooks each side.

Tenth segment, 3 setæ and 18 hooks, but on one side the latter were all imperfect, mostly with the comb undeveloped.

Eleventh segment, 2 setæ and 14 hooks each side.

In the last specimen the rows of 24 hooks in the ninth segment measured 0·08 mm. wide; the rows of 18 hooks of the tenth segment 0·072 mm. wide; and the rows of 14 hooks of the last segment 0·06 mm. wide. The height of the rows corresponding with the length of the hooks was 0·025 mm.

The intestinal canal of *Manayunkia* is of extreme simplicity, consisting of a median tube alternately dilated within the segments and contracted in the intervals of the latter, without any other conspicuous division into more distinct portions. The widest expansions are within the fourth to the seventh segment, inclusive, but are also variable in these. Afterwards the intestine becomes narrower to the anus, which opens ventrally in the last segment. The mouth is funnel-like, capacious, and without armature of any kind. Along the intermediate two-thirds of the canal the walls are of a yellowish brown hue. Within the intestine in the seventh segment, and within the terminal portion, active ciliary motion was observed. The intestine, as usual in other annelides, is connected by thin diaphragms to the wall of the body-cavity in the intervals of the segments. The intervals are occupied with liquid with multitudes of floating corpuscles.

The ovaries, with ova in different stages, occupy the fourth to the sixth segment inclusive. Within the lower part of the head, extending thence into the third segment on each side, there is a large elliptical organ, which I have suspected to be the testicle, though I did not examine its structure.

I was greatly puzzled in the attempt to ascertain the arrangement of the vascular system of *Manayunkia*, and am in doubt as to the following explanation I give of it. The blood is of a bright green color, and in many positions serves clearly to define the course of the larger vessels. As represented in figure 1, the chief blood-vessels appear to be a large one on each side of the intestinal canal, closely following the course of this so as to seem to form a green coat to it. In each segment of the body the vessel gives off a pair of lateral branches apparently uniting in a loop. In the head the two main vessels leave the sides of the intestine, and after forming a close flexure or a sinus at the base of each lophophore, proceed onward through the interior of the larger pair of tentacles. In viewing the worm in any direction, the two main vessels so constantly appeared at the sides of the intestine, that I at first took them for the walls of the latter itself. The condi-

tion I did not comprehend until I found an explanation in the following paragraph in Claparede's Recherches sur la structure des Annelides Sedentaires, Geneva, 1873, page 76 : "M. de Quatrefages has discovered that in certain Serpuliens," to which family *Fabricia* and *Manayunkia* belong, "the intestinal canal is enclosed in a lacuna or rather a veritable sheath taking the place of a dorsal vessel." Claparede adds from his own observations the statement "that a number of the sedentary annelides present the same peculiarity of having the intestine included in a vascular sheath playing the part of a dorsal vessel." In this view the two chief vessels, in figure 1, at the sides of the intestine, are to be regarded as sections of the vascular sheath enclosing the latter. The principal movement observed in the vessels of *Manayunkia*, consisted in an incessant pumping of blood into those of the two larger tentacles alternating with contraction and partial expulsion of blood from the same.

The nervous system of *Manayunkia* I did not attempt to investigate. A well-developed eye occupied the head at the side of the gullet. It exhibited a clear vitreous humor in a choroid cup. No trace of eyes was to be detected in the terminal segment of the body, such as exist in *Fabricia*.

In several instances in which I have extracted *Manayunkia* from its tube, a number of young ones, about half a dozen, have been liberated, from which it appears that the eggs are laid within the tube, there hatched, and the young then retained under the care of the parent until sufficiently developed to be able to care for themselves.

Figures 8–13, Pl. IX, represent an ovum and a series of young in different stages of development, which were obtained together with others in the same condition from three tubes.

The ovum, fig. 8, about 0·2 mm. long, obtained with several similar ones from a tube, exhibits a central mass of large yolk-cells enclosed by a layer of smaller ones. Fig. 9 represents an embryo, which accompanied the former. It was motionless and devoid of cilia. The yolk-cells appear to have been resolved into a stomachal cavity. The embryo was about the same size as the ovum. Fig. 10 represents a more advanced embryo, from the same tube. It measured 0·265 mm. in length. The intestine indicates a division into eight segments. Fig. 11 is a more advanced stage of development of the worm from another tube.

It measured one-third of a millimetre in length. The body-wall and intestine are quite distinct, the latter exhibiting eight segments. The tentacular lobes have commenced development. Fig. 12 represents an individual further developed, from the same tube as the former. It measured half a millimetre long. The body is distinctly divided into nine segments, of which eight bear a pair of setæ on each side. The tentacular lobes exhibit each the rudiments of four tentacles. Eyes also have made their appearance. Fig. 13 represents a young worm, from another tube, the only one accompanying its parent. It measured 0·72 mm. long. The body is divided into the same number of segments as in the former. The tentacular lobes have developed each four tentacles with the rudiment of a fifth. Podal hooks could be detected in none of the segments except the last, in which there were three comb-hooks on each side. Another young individual observed, from another tube, about the same size of the preceding, had five tentacles on each side, but was otherwise exactly similar. Another individual three-fourths of a millimetre long, with five tentacles on each side, had one more setigerous segment than in the others.

The species of *Fabricia* to which I referred in the beginning of the present communication, and which I examined with particular interest on account of the near relationship of ***Manayunkia*** to it, is the same as that described by Prof. Verrill, as being common from New Haven to Vineyard Sound and at Casco Bay (see Report on the Sea Fisheries of New England, Washington, 1873, p. 619). I first noticed the worm at Newport, Rhode Island, in 1858, and found it abundantly at Bass Rocks, Gloucester, Mass., in 1882. It occurred on rocks between tides, under a luxuriant growth of *Fucus vesiculosus*, with its tubes projecting from among the mud and sand firmly fixed together with multitudes of little mussels about the roots of the sea-weed.

The worm is three or four millimetres long and of a yellowish or yellowish brown hue, with more or less reddish. The body is compressed cylindrical and slightly tapering behind, and is divided into twelve segments, including the head. This is prolonged dorsally in a half elliptical process or upper lip. The vertex supports on each side a trifurcate lophophore, each fork of which is provided with a double row of narrow cylindrical tentacles invested with cilia.

The segments succeeding the head are furnished with lateral fascicles of podal setæ, and, except the first one, are provided with fascicles of podal hooks, all of which have the same general arrangement and form as those described in *Manayunkia.* The fascicles of podal setæ, from the first to the eighth segments, usually contain six or seven setæ; those of the ninth and tenth segments, three or four setæ; and those of the eleventh segment two or three setæ. The longer setæ, figs. 14, 15, resemble those of *Manayunkia*, consisting of a straight rod with a feather-like vane ending in a long point and bent at an obtuse angle from the rod. The stouter setæ, fig. 16, have the same form, but differ in the variably much shorter proportion of the vane. The setæ range from 0·12 to 0·25 mm. long.

The first setigerous segment possesses no podal hooks, as in the case of *Manayunkia.* The fascicles in the succeeding segments to the fourth contain each eight or nine hooks, and those following to the eighth, inclusive, six or seven hooks. The hooks of the remaining three segments, as in *Manayunkia*, are very different from those of the anterior segments, and are arranged in close transverse semicircular rows of from 20 to 28 in each row.

The anterior podal hooks consist of a curved handle ending in a short robust hook, like those of *Manayunkia*, but differing in the hook being furcate, or even divided three or four times on the dorsum, as represented in figs. 17, 18. These podal hooks usually measure about 0·08 mm. long.

The posterior podal hooks resemble the corresponding ones of *Manayunkia* as represented in fig. 19. They measure from 0·035 to 0·04 mm. long.

The intestinal canal of *Fabricia* has the same simple character as that described in *Manayunkia.* The mouth has a pair of palp-like appendages, situated between the lophophores. The vascular system appears to exhibit the same arrangement as in *Manayunkia*, but the blood is of a red color.

Fabricia is remarkable for being furnished with a pair of eyes to the terminal segment of the body as well as to the head. The eyes are of simple character, but equally well developed at both extremities of the body. They consist of a black pigment cup, including a spheroidal vitreous body. In several instances I observed a curious variation of the eyes in different individuals and on the different sides of the same individual. Fig. 20 repre-

sents the usual form of the cephalic eye. Figs. 21 and 22 represent the two eyes of the same individual, the right eye apparently double. Fig. 23 represents another double eye, but with the lens directed backward. Fig. 24 represents a caudal eye.

The tube of *Fabricia* is composed of exceedingly fine particles of quartzose sand and indefinite particles of mud.

I observed no specimens of this genus, exhibiting the reproductive organs in the condition usual in mature ones of *Manayunkia*.

In several instances I observed a few free eggs and young worms of 0·12 mm. in length within tubes in company with the parent, but did not have the opportunity of investigating them.

Manayunkia mainly differs from *Fabricia* in having a pair of simple or undivided tentacular lophophores instead of having them trilobate; in the possession of an inner pair of larger tentacles which receive a continuation of the main trunks of the vascular system; and in having no eyes to the terminal segment of the body.

EXPLANATION OF THE FIGURES OF PLATE IX.

FIG. 1. MANAYUNKIA SPECIOSA. Magnified about 50 diameters. The worm in the ordinary condition of extension, with its tentacles spread.

FIG. 2. A stock of five tubes. Magnified about 4 diameters.

FIG. 3. One of the longer podal setæ from the second setigerous segment of the body. 666 diameters.

FIG. 4. One of the shorter podal setæ, from the same. 666 diameters.

FIG. 5. A podal hook, from the same. 666 diameters.

FIG. 6. A row of podal hooks, from the last segment of the body. 250 diameters.

FIG. 7. A podal hook from the same row. 666 diameters.

FIG. 8–13. Egg and different degrees of development of the young of *Manayunkia*. 100 diameters.

FIG. 14–16. Podal setæ of *Fabricia Leidyii*, Verrill. 500 diameters.

FIG. 17, 18. Podal hooks of anterior segments. 500 diameters.

FIG. 19. Podal hook of posterior segment. 666 diameters.

FIG. 20–24. Eyes of *Fabricia*. 250 diameters.

FIG. 20. A cephalic eye of the usual form.

FIG. 21, 22. Right and left cephalic eyes of the same individual.

FIG. 23. A double cephalic eye.

FIG. 24. A caudal eye.

NOTE ON A COLLECTION OF FOSSILS FROM THE HAMILTON (DEVONIAN) GROUP OF PIKE CO., PA.

BY PROF. ANGELO HEILPRIN.

Among a small collection of invertebrate fossils obtained from the Hamilton rocks of the vicinity of Dingman's Ferry, Pike Co., by Drs. E. C. Hine and J. Holt of this city, and now in their possession, I have been able to identify the following species and genera. Most of these are probably not new to the State, but inasmuch as the palæontology of Pennsylvania has been but very imperfectly (indeed, one might say, not at all) worked up, and the fossils there occurring, although known in some part to amateur collectors, but very sparingly recorded, it has appeared to the writer that the publication of the present list, as well as of others of a similar character to follow, may not prove entirely useless, tending toward a more complete knowledge of the extinct fauna of the State.

ACTINOZOA.

Heliophyllum Halli.

MOLLUSCA.

Fenestella, sp. indet.
Crania Hamiltoniæ.
Spirifer mucronatus.
Spirifer granuliferus.
Spirifer medialis?
Streptorhynchus Chemungensis.
Orthis, sp. indet.
Chonetes, sp. *setigera?*
Aviculopecten duplicatus? or *A. scabridus?*
Limoptera macroptera.
Paracyclas lirata.
Grammysia bisulcata.
Orthoceras (impression).
Nautilus or *Goniatites* (septal lines too imperfectly preserved for generic determination).

CRUSTACEA.

Phacops bufo, a complete specimen and several tail-pieces.
Homalonotus Dekayi, several well-preserved fragments unquestionably belonging to this species.

Crinoid stems or impressions belonging to several distinct species are common in the rock-masses. It may be noted that Prof. I. C. White, during his survey of Pike and Monroe counties, was unable to discover any traces of trilobites in the rocks of this series. "Not a single specimen of a *Trilobite* was observed in all this thickness of rock at the many localities where it is exposed for observation within the district" (Second Geological Survey of Pennsylvania, Report of Progress, G 6, p. 112, 1881).

ON THE ANATOMY OF ANCYLUS FLUVIATILIS O. F. Müller AND ANCYLUS LACUSTRIS Geoffroy.

BY BENJAMIN SHARP, M. D., PH. D.

This paper first was written in German, and served as an inaugural dissertation for the Philosophical faculty at the University of Würzburg, in Bavaria. In rewriting it I have merely omitted a few unimportant details, and made one or two slight changes.

Introduction.

The position of these little animals in the system of classification was long a subject of dispute. At first they were placed by Linnæus[1] in the genus *Patella*, but in the same year (1767) Geoffroy[2] formed an especial genus for them, which he called *Ancylus*, on account of the resemblance of the shell to a Phygean cap (Α'γκνλος).

The specimens of *fluviatilis*, which I had for examination, were obtained in the Main near Würzburg, and in a branch of the same near Gemünden—the only place in which the other species could be had was in a small pond near Aschaffenburg.

The work was carried on in the laboratory of Prof. C. Semper, at Würzburg, and I here take the opportunity of expressing my sincere thanks to him for his kindly advice and assistance.

Ferussac placed this genus, in 1837, among the Pulmonata, to which order it undoubtedly belongs.

Moquin-Tandon[3] believed that *Ancylus* was amphibian in its habits. I do not believe that the animal under natural and healthy conditions ever approaches the surface of the water. He says: "Does the animal breathe free air or that air dissolved in water?" Ferussac[4] said positively that the animal was compelled to come to the surface to breathe. L. Agassiz,[5] Depuy, and others, were of the same opinion. To prove this, Moquin-Tandon[6] made the following experiments:—

[1] Linnæus, Syst. Nat., 1767.

[2] Geoffroy, Trait. somm. d. Coquil fluv. et terres., etc., Paris, 1767.

[3] Moquin-Tandon, Recher. anatomico-physiol. sur l'Ancyle fluviatile (*Ancylus fluviatilis*), Journal de Conchyliologie, Tome iii, 1852, p. 124.

[4] Ferussac, Dict. class. d. Hist. Nat., Tome i, 1822.

[5] L. Agassiz, Act. Helvit., 1841.

[6] Recher. anat. physiol. s. l'Ancyle, etc., pp. 124–126.

Many animals were placed in a vessel of water, and the following facts were observed:

1. That not all the animals found the need of coming to the surface to breathe, and that many stayed at the bottom of the vessel.
2. That the need of air did not seem very strong, as they came slowly to the surface.
3. That certain individuals remained in the upper portion of the fluid.
4. That many went only partially out of the water.
5. That others left the water entirely, but remained in the neighborhood of it.

These and other facts show that they breathe air and are not water animals. Further on he says:—

1. Seven animals were placed in tall champagne-glasses, which were filled with water; in the middle of the glass was placed a partition, so that the animals could not come to the surface; the water, however, could freely circulate. The animals lived three days, at which time they were taken out.
2. Three individuals were placed in 45 cu. mm. of well-water, and these lived only eight hours.
3. Six *Ancyli* were placed for three days in 25, 30 and 50 cu. mm. of river-water; all remained living and some deposited eggs.

This last experiment seems to prove that they are not amphibious.

I made essentially the same experiments with the same results, and further found that when the *Ancyli* were placed in aquaria, in which there was running water, they never came to the surface; if, however, the water was not fresh, they would invariably come to the surface of the water. I think, therefore, that the apparent amphibian habits are due to the fact that the water was not sufficiently aërated. Probably the cause of such rapid death in the case of the animals that were placed in the well-water, was the presence in it of such a small percentage of air.

I will first take up the anatomy of both species in general, and describe the differences between them, and then consider the special part, which consists in:—

1. Formation of the radula.
2. Observations on the nervous system.
3. The anatomy of the excretory organ.

General Anatomy.

In the following description I will first consider the anatomy of *A. fluviatilis* as a basis, for the anatomy of this is tolerably well known from the papers of Carl Vogt [1] and Moquin-Tandon.[2] The first paper is short and incomplete, containing at the same time many mistakes, while the latter, unfortunately, is without plates. On *A. lacustris* no paper has as yet appeared, as far as I know.

The shell of *A. fluviatilis* is much larger than that of *A. lacustris.* In both species the form is that of a depressed cone and of a dirty brown color. In *A. fluviatilis* it is said [3] that the shell is wound to the left. I have never as yet seen a shell of *A. fluviatilis* which was in the least unsymmetrical, for the apex of all the specimens that I have examined lay in the median line, only rolled a little backwards.

In *A. lacustris*, however, the apex of the shell is wound slightly to the right, and this character has been considered sufficient to place this form in a separate genus, that of *Acroloxus* (Beck, 1837), or *Vellitia* (Gray, 1840), which, however, is not generally accepted.

The opening of the shell (*apertura*) is oval in both species; in *A. lacustris*, however, it is a much longer oval than in *A. fluviatilis.*

The shell contains such a quantity of conchyolin, that if it be thrown into an acid and left there until all the carbonate of lime be dissolved away, the organic framework of conchyolin remains perfect and the form unchanged.

If a piece of this be placed under the microscope a large number of the siliceous cases of diatomes are seen. This is easily explained: the diatomes are found in large quantities on the objects on which the *Ancyli* are found, and as they are so small, they can easily pass between the mantle and the shell and then become covered by a layer of mother-of-pearl or nacre which is secreted by the external surface of the mantle and by which the shell grows in thickness. This process of imbedding diatomes in nature is similar to that effected artificially by the Chinese, when they place their little leaden images between the mantle and the

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[1] Bemerkungen über den Bau der *Ancylus fluviatilis.* Archiv für Anat. und Physiol. (Müller), 1841.

[2] Recher. anat. physiol. s. l'Ancyle, etc.

[3] C. Claus, Grundzüge d. Zoologie, Marburg, 1880–82, and others.

shells of bivalves, and allow them to become coated with mother-of-pearl.[1]

The mantle.—If the shell be carefully removed from the animal, the form of the body is found to be like that of the shell, namely, a depressed cone, and covered with a thin white membrane, the mantle. The base of the mantle, or that part which comes in contact with the aperture of the shell, is thickened and separated from the body, so that a deep groove is found running around the foot bounded externally by the internal surface of the mantle. The deepest point of this groove is at that point where the mantle and foot join. From this point, or the base of the groove (looking at the animal from below), hangs the gill, between the foot and the mantle, on the left side in *A. fluviatilis*, and on the right in *A. lacustris*. The inferior portion of the external surface of the mantle has a deposit of black pigment; this band of black pigment is not present in *A. lacustris*.

Organ of locomotion.—The only organ of locomotion is the foot, which is an oval muscular disk. The shape is like that of the aperture of the shell to which it belongs. The foot is formed of muscular fibres which run in four different directions, and between which the lacunæ or blood-spaces are found. One system of muscular fibres passes from before backward (longitudinal fibres); another, perpendicular to these, passes from side to side (transverse fibres). The other two systems are continuations of the muscle that binds the body to the shell. These latter fibres pass perpendicularly from the shell, and entering the foot, spread out fan-like into it, so that some of the fibres are almost horizontal and others almost perpendicular to the sole of the foot; these may be called lateral fibres. The animal holds itself to objects on which it creeps, by the foot, which acts like a sucker. If the animal be disturbed it draws the shell tightly downwards so that the soft parts are completely covered by the shell and thus protected. The movement of *Ancylus* is very slow. It never swims, as does, for example, *Limnæus*, on the surface of the water, as Gray and

[1] An interesting account of this process may be found in F. Hague, Ueber d. natürliche u. künstliche Bildung der Perlen; and C. Th. von Siebold, Ueber d. Perlenbildung chinesischer Süsswasser-Muscheln, als Zusatz z. d. vorhergehenden Aufsatz. Zeitschr. f. wiss. Zool., Bd. viii, 1857.

Turton[1] observed. Moquin-Tandon[2] states that he had never observed the animal creeping or swimming on the surface of the water.

The shell of the animal is fastened to the body by a muscle, which, as already said, passes perpendicularly from the shell and enters the foot obliquely, and with which it coalesces, forming with the foot the sides and floor of the visceral cavity respectively. In the figure (Pl. X, fig. 1) we have a cross-section of the animal about the middle, drawn with a camera lucida, and to which I have added the lines *s*, which represent a cross-section of the shell. The letters *m c* represent the musculus cochlearis, which enters the sides of the foot; *q m* are the transverse fibres. The longitudinal fibres are not represented, as they are transversely cut and only appear as points.

In the musculus cochlearis of the left side in *A. fluviatilis* and on the right of *A. lacustris* a cavity is found in which the heart is situated. The walls of this cavity form the pericardium.

The gill.—In the space between the foot and the mantle in *A. fluviatilis* on the left side is found a broad, leaf-like fold of the integument, the gill. This fold or gill reaches down as far as the lower border of the mantle. In the figure (Pl. X, fig. 1) the gill (*k*) is represented on the right side of the section, although really on the left side of the animal, and we must imagine that we are looking at the animal from the front. The gill is one-third as long as the whole animal and lies in the middle third of the body. In the living animal it is of a lighter color than the surrounding tissues and the surface of it is smooth. Although the gill of *A. lacustris* is on the right side of the animal, its relative position is the same as in *A. fluviatilis.* The space between the foot and the mantle, into which the gill hangs, may be called the branchial chamber.

I believe that the organ which Moquin-Tandon[3] speaks of as the lobe auriforme is what I prefer to call the gill. It is physiologically one, as we will presently see.

The whole surface of the gill is covered with ciliated epithelium, and the internal part is formed of cutis, consisting of loose connective-tissue fibres which run in all directions and between

[1] Manual of Shells, ed. ii, 1840.
[2] Recher. anat. physiol. s. l'Ancyle, etc., p. 35.
[3] Recher. anat. physiol. s. l'Ancyle, etc., p. 12.

which the blood-spaces (lacunæ) are found. A long continuous one runs the whole length of the inferior border of the gill, and is in connection with the mantle-vein. The nuclei of the connective-tissue fibres are very distinct; the rectum passes perpendicularly through the tissues of the middle of the gill, and opens at the anus, situated on the external surface.

Several organs open into the branchial chamber; in the middle of the external surface of the gill, as said, opens the anus. In *A. lacustris*, when the gill is on the right side the rectum and anus also are on that side. Close behind the base of the left tentacle in *A. fluviatilis*, is found the male genital pore or opening, and close behind this the female; as with the anus, these openings are on the right side of *A. lacustris;* in *A. fluviatilis*, on the internal surface of the left mantle, is found the minute opening of the excretory organ, the kidney, which lies embedded in the tissues of the mantle; in *A. lacustris* the kidney is on the right side; thus we see that four organs open into the branchial chamber, the ♂ and ♀ genital openings, the anus, and the kidney.

The alimentary canal.—The mouth, which opens on the inferior surface of the body, is surrounded by three lips; the two anterior lips are placed together so that they form an inverted V (Λ); the open part of the V is closed by the under lip, which is the extreme anterior end of the sole of the foot.

The mouth leads into a small tube, which passes perpendicularly upwards, opening on the floor of the buccal mass (Plate X, fig. 2 *m*). About half-way between the mouth and the buccal mass is situated the horseshoe-shaped jaw, which is placed in the anterior wall of the tube. The jaw consists of a single membrane of conchyolin, upon which are situated numerous little teeth or denticles. Moquin-Tandon says, however, that "*Ancylus* possesses three jaws, disposed as those in *Limnæus*—a transverse one above, and two vertical ones on the sides, * * * the borders of which are formed of a series of little denticles."[1] I do not find this to be exactly the case, but agree with Keferstein, who says: "In *Ancylus* we see, instead of the simple jaw, a large number of long pieces, which are tolerably symmetrically arranged, and encircle

[1] *L'Ancyle* possède trois mâchoires, disposées comme celles des *Limnées*, une transversale, en haut et deux verticle, sur le côtés * * * celles des bords forment comme une serie de petites denticules: Reche. anat. physiol. s. l'Ancyle, etc., p. 16.

the upper (anterior) side of the cavity of the mouth."[1] These long pieces are the denticles.

The buccal mass, which is of a spheroidal form, lies in the head, between the two tentacles. Immediately over the mouth is found the opening of the œsophagus, and in the middle between these two openings projects the tongue, which is covered by the radula. The odontophore is in *Ancylus* exceptionally long, and reaches from the buccal mass to the middle of the body. The opening of the odontophore lies in the superior part of the buccal mass: the first part of the odontophore itself lies sunken in a groove of the buccal mass, so that seen from the side it appears to spring from the posterior wall.

The diagramatic figure (Pl. X, fig. 2) represents a longitudinal section of the odontophore (*od*), which opens into the spheroidal buccal mass. In the figure the odontophore is relatively much shorter than it is in reality.

After the odontophore leaves the buccal mass it passes backwards, lying directly under the œsophagus and parallel with it; then it passes in *A. fluviatilis* to the right, and in *A. lacustris* to the left side. The œsophagus and odontophore are at the position of insertion in the buccal mass, separated from one another by the commissure of the buccal ganglia. Soon after leaving this commissure the odontophore passes to the side and then upwards and over the œsophagus, so that in the latter part of its course it lies above it.

The alimentary canal has in both species nearly the same form, except that the windings are different. The œsophagus arises in the middle of the superior and anterior angle of the buccal mass, directly over the position where the mouth enters from below (Pl. X, fig. 2 *oe*).

The salivary glands open by a very short duct into the œsophagus, immediately behind the position of its exit from the buccal mass. These glands are two in number, and lie on the side of the œsophagus.

The stomach is of a good size and spheroidal in form, the walls are thick and muscular. It is embedded in the liver, which lies

[1] Bei *Ancylus* sehen wir an die Stelle der einfachen Kiefers ein grosse Menge kleiner länglicher Stücke treten, welche ziemlich symmetrisch angeordnet, die Oberseite der Mundhöhle umgürten. Bronn's Klass. u. Ord. d. Thierreichs, Bd. iii, 2 Abth., 1862–1866, p. 1190.

beneath, behind and, in *A. fluviatilis*, on the right side; the left side being covered by the albuminous gland. In *A. lacustris* the relation is only reversed, so that the liver lies on the left side of the stomach and the albuminous gland on the right.

The intestine passes from the stomach at about the middle of its superior wall and then passes into the liver, forming a loop, which is clearly visible when the shell is removed in *A. fluviatilis*, but difficult to be seen in *A. lacustris*. After a few turns it passes to the left side of *A. fluviatilis* and to the right in *A. lucustris*, and proceeds downwards, entering the gill and opening on the external surface of the same.

I will here call attention to a peculiar ring of long cylindrical epithelial cells which lies in the walls of the rectum in *A. fluviatilis*. It is in the middle of that part of the rectum which lies in the gill. These cells are ciliated, as are indeed the epithelial cells of the whole intestine.

The physiological significance of the cells forming the ring I have in no way been able to determine.

In both species the liver is large and fills up the greater part of the body-cavity. It consists of a number of follicles; each follicle is formed of an external tunica propria and an internal layer of large cells. These cells secrete the bile, which is led into the intestine, close behind its exit from the stomach, by means of three ciliated ducts.

The vascular system.—As the vascular system of *Ancylus* differs so little from that of mollusca in general, it is not necessary to go into details. The heart, which is an arterial one, is formed of two parts, an auricle and a ventricle. In *A. fluviatilis* it lies on the left side of the body above the gill and in advance of the rectum. The auricle, the smaller of the two parts, is divided from the ventricle by a contraction, and at this point a valve is found opening into the ventricle. From the end of the ventricle arises the aorta, which soon divides into two branches; one of these passes to the head (*Arteria cephalica*) and the other supplies the viscera. These two branches divide into smaller ones, and finally open into the body-cavity, where they pour out their blood. The blood, which can freely circulate in this cavity, is collected into the lacunæ of the foot which open in the floor of the body-cavity. One of these lacunæ, which can almost receive the name of vein, passes from the foot into the mantle and becomes

connected with another large lacuna, the mantle-vein, which lies above the tubular part of the kidney. It then sends a branch downwards into the gill, and after passing through this, again becomes joined to the mantle-vein, so that both pass into the auricle together.

The heart lies in a closed sack, the pericardium, on the external walls of which it is fastened (Pl. X, fig. 3 *Ht*). The external wall of the pericardium is only separated from the shell by the mantle, while the other parts lie in contact with the musculus cochlearis. The wall of the pericardium consists of a tunica of connective tissue, in which, here and there, the nuclei can be distinctly seen. The lobe auriforme of Moquin-Tandon[1] is intimately connected with the vascular system, and seems to aërate the blood, and physiologically is a gill.

The generative organs.—*Ancylus*, as is well-known, is hermaphroditic. The hermaphroditic gland or ovitestis, in which sperma as well as ova are formed, lies in the superior and posterior part of the body, immediately below the apex of the shell. In *A. fluviatilis* it lies in the median line, while in *A. lacustris*, where the apex of the shell is wound to the right, the ovitestis also is on the right side of the median.

When the shell is removed from the animal, the ovitestis is easily seen by its having a much lighter color than the surrounding parts.

The larger part of the genitals in *A. fluviatilis* is on the left side of the body, and in *A. lacustris* on the right side. Stephanoff[2] believes that albumen is secreted by the epithelial cells of the ovitestis. I cannot indorse this belief, as I never observed albumen in the ovitestis, and, further, there is a well-developed albumen-secreting gland present which opens into the oviduct. This albuminous gland has been described by C. Vogt[3] and Moquin-Tandon.[4]

I do not consider it necessary to enter into a detailed account of the genitals, as they have been completely described by

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 12.

[2] Ueber d. Geschlechtsorgane u. Entwickl. v. Ancylus fluviatilis. Mem. de l'Acad. d. Science d. St. Petersbourg, Tome X, No. 8, 1866, p. 2.

[3] Bemerk. ü. d. Bau d. Ancylus fluv., etc.

[4] Recher. anat. physiol. s. l'Ancyle, etc., p. 540.

Moquin-Tandon[1]; suffice to say that Stephanoff,[2] in his description of these organs, made many blunders, and at the same time did not seem to have known of the existence of Moquin-Tandon's work.

I.—The Formation of the Radula.

The radula is formed in the odontophore. This consists of four parts, which can be best understood by a reference to the figures. Fig. 4 *a* (Pl. X) represents a horizontal section through the posterior portion of the odontophore. Fig. 4 *b* (Pl. X) is a transverse section of the same. Both figures serve to illustrate the four parts making up the odontophore.

First, we have to distinguish the tongue-papilla (Pl. X, fig. 4 *ac*), which fills up the interior of the odontophore; this is surrounded, as is seen in the drawing, by the radula (*r*). External to the radula is the epithelium of the radula. If we make a transverse section through the odontophore (fig. 4 *b*), we find that the radula (*r*) has the form of the letter U, and consequently does not entirely surround the papilla, while the epithelium of the radula (*s*) encircles its external surface. At the open part of the letter U, where the radula is wanting, the epithelium passes gradually into the papilla.

The line *x* in the transverse section (fig. 4 *b*, Pl. X) represents the position of the horizontal section (fig. 4 *a*).

The only part not mentioned now is the fourth and most important of all. I propose to describe it in *Helix aperta*, as the parts in this form are larger and more distinct than in *Ancylus*.

Fig. 5 (Pl. X) represents the posterior part of the odontophore, drawn by a camera lucida. It represents that part of the odontophore which is enclosed by the bracket (*a*) in fig. 4 *a*.

In the drawing we see at that point where the tongue-papilla coalesces with the epithelium of the radula, five large, sharply defined cells (*1*, *2*, *3*, *4* and *5*), which I propose calling the matrix of the radula—thus differing from other writers on the subject, who have not seen these cells, and who call the matrix that part to which I have given the name of tongue-papilla.

Before I pass to the formation of the radula I will first take up the histology of the separate parts of the odontophore in *Helix aperta*.

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 337.

[2] U. d. Geschlectsorg. u. d. Entwick. von Anc., etc.

As has already been described by Semper,[1] the tongue-papilla consists of two layers. The internal layer is formed of loose connective tissue, the fibres of which run in every direction, and in which can be distinctly seen the large fusiform nuclei; most of these nuclei are bipolar, although here and there a tripolar one can be seen.

The external layer of the tongue-papilla is made up of cells which possess a large nucleus, and the cell-wall, if seen at all, is very faintly evident; this layer seems more to be a homogeneous mass of protoplasm, in which are embedded large numbers of nuclei; here and there fine lines may be seen, which may be regarded as the cell-walls (Pl. X, fig. 5 *m*). This layer comes in close contact with the radula and its teeth. The axes of these oval nuclei seem to have a definite direction. In the posterior part they are all directed to the point where the radula begins, while those further forward become perpendicular to the radula itself.

When the object is well stained the difference between these two parts of the tongue-papilla is distinctly seen; the loose internal part being of a light color, while the external part, rich in nuclei, takes a very dark shade.

In *Ancylus* the demarkation between these two parts is not so pronounced as in *Helix*. The peripheral part of the tongue-papilla, rich in nuclei, passes gradually into the loose, pale, internal part (Pl. X, fig. 5 *a*).

The epithelium of the radula, *s* (Pl. X, fig. 5), is composed of a single layer of long cylindrical epithelial cells, with well-defined nuclei and distinct cell-walls. These cells are much longer at the posterior part of this layer, *i. e.*, at the point where they lie in contact with the matrix of the radula, than those nearer the mouth. The larger cells rest obliquely on the tunica and parallel to the large cells of the matrix; as they become shorter they become more and more perpendicular, as is seen in the figure (Pl. X, fig. 5 *s*). The nuclei are small, although with a high power they can be distinctly seen. When thus examined they have the same general appearance of nuclei, and are placed in that part of the cell nearest to the tunica.

Between these long cylindrical cells of the epithelium of the radula and the posterior part of the odontophore are seen five

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[1] Zum feinern Bau der Mollusken-Zunge. Zeitschr. f. wiss. Zool., Bd. ix, 1858.

very large cylindrical cells (Pl. X, fig. 5, *1*, *2*, *3*, *4* and *5*), to which I have given the name of matrix. When a horizontal section is examined these cells are very striking and easily distinguished by their having a much lighter color than the surrounding parts; each one of these five cells has a peculiar and characteristic form. The cell marked *1* stands obliquely to the tunica, and that end farthest from the tunica is rounded or dome-shaped; all the other of these five cells, with the exception of *4*, are pointed at the corresponding extremity, and also placed obliquely to the tunica. In *4* this condition is reversed, the pointed extremity being nearest to, but not touching, the tunica. The blunt end of this cell is in contact with the radula, and the point is inserted between cells *3* and *5*.

The protoplasm of these five cells of the matrix is quite clear, taking only a slight reddish tinge with borax (Grenacher's) carmine. There is not the slightest trace of a granulated structure to be found. The nuclei of these cells are very large and oval in form; their size is about twice that of the nuclei that are found in the neighboring tongue-papilla (Pl. X, fig. 5 *m*). The structure of these nuclei differs somewhat among themselves; some contain only one nucleolus, in others it is more or less broken up, and others still have a granular appearance.

The cells *1*, *2* and *3* form the basal membrane (Pl. X, *B. M.*) and cell *4* the bases of the teeth. The convex end of cell *1* secretes a mass of conchyolin, which is the beginning of the basal membrane. The posterior part of this membrane, namely, that part which lies against cell *1* in the figure (fig. 5), has the appearance of a hook, the point of which lies between cells *1* and *3*, just overlapping the tip of the point of *2*. These three cells are those which take part in the formation of the basal membrane of the radula, the cell *3* forming the upper, and cell *1* the lower face of this so-called hook, and cell *2* probably adds a little to the point. This hook-like appearance is only present in longitudinal sections. In reality, naturally, this part of the basal membrane is not a hook, but a sharp edge, which is curled over and fits into a groove formed by two rows of cells; cells like cell *1* (fig. 5) forming the anterior, and cells like cell *2* forming the posterior wall.

The formation of the teeth is carried on by the cell marked *4*. This is triangular in shape with the base abutting the posterior face of the tooth, *d* (Pl. X, fig. 5). I believe that this cell *4* is

formed by division from cell *5*, and dies when the tooth is fully formed, and the remains of this cell are carried forward between the teeth as the radula advances. This can be the only way, for if the cell remained living and continued to secrete conchyolin instead of a series of teeth, we would have simply a solid layer formed on the top of the basal membrane. By a continuous secretion of the cells *1* and *3*, the basal membrane moves or is pushed forward, and thus carries the tooth (*d*) along with it; after this has proceeded for a short distance (viz., the distance of the space between the teeth), a new cell, which has been formed from cell *5*, is ready to commence secreting again, and a new tooth or transverse row of teeth begins to form, and thus the process continues.

The caps of the teeth are shaded darkly in the figure (Pl. X, fig. 5), and are formed after the base of this is completed by cell *4*. The caps are formed by the cells that make up the external layer of the tongue-papilla. If the preparation has been colored with picro- or borax-carmine the basal membrane and bases of the teeth do not color, or only take a slight tinge, while the caps of the teeth are colored darkly. This shows, I should think, that the basal membrane with the bases of the teeth and the caps are of two different formations.

The covering of the odontophore, which may be called the sheath, consists of two layers. The internal, *c'* (Pl. X, fig. 5), which is made up of a simple layer of connective-tissue cells, passes directly into the internal or loose part of the tongue-papilla (*e*), and it seems that this layer is merely a continuation of this part of the papilla. The external layer of the sheath, which covers the whole of the odontophore and is continuous with that which covers the buccal mass, consists of a more compact layer of connective-tissue fibres, in which, as in the internal layer, distinct nuclei may be seen.

In the odontophore the teeth of the radula are directed backward. The radula passes from the posterior part of the odontophore and extends to the opening in the buccal mass, over the tongue, where it makes a bend and returns on the under surface of the tongue; the teeth are placed reverse to those on the upper surface, which are directed backwards, while those on the under surface are directed forwards. In fig. 2 (Pl. X), I have given a diagramatical longitudinal section of the buccal mass and the

odontophore, in order to show the direction of the teeth on the radula (*r*). The arrow (*c*) in the same diagram shows the direction in which the radula moves when the animal is rasping the food.

As regards the disappearance of the worn-out and useless teeth, Semper says: "There are only two ways possible, since the view that each tooth continually grows is not to be considered at all. Once we thought, as did Troschel, Claparède and others, that the radula gradually moved forward, and that the forward teeth that were worn out were thus gradually replaced; or there must be a periodical shedding of the radula. This latter view seems to me the most natural."[1]

Above it was shown that the epithelium of the radula had no connection whatever with the formation of the radula. On the other hand it was observed that the radula as well as the teeth, *a*, *b*, *c*, *d*, etc. (Pl. X, fig. 5), with the exception of the caps, grew from behind, that is, from the cells of the matrix *1–5* (Pl. X, fig. 5).

From this we see that the radula grows at the posterior end of the odontophore and must gradually be shoved forward, and that the teeth that are used up at the mouth are gradually being replaced from behind. The view of a renewal of the radula by a periodical shedding, as Semper thought most probable, is consequently excluded. In many sagittal sections it is easy to see the anterior part of the radula breaking away at the point, *x* (Pl. X, fig. 2). At this point separate teeth and parts of the radula could be seen, and they would have been cast out at the mouth.

Trinchese[2] gives in his paper on *Spurilla Neapolitana* a short notice on the development of the radula in this species. He speaks of from five to seven cells which go to form the teeth, and also the cells forming the layer which I have called the epithe-

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[1] "Hier sind nur zwei Fälle möglich, da die Annahme, dass jeder Zahn fortwährend wachse, nicht weiter zu berücksichtigen ist. Einmal könnte man nun annehmen, dass, wie es auch Troschel, Claparède u. A. thun, die Reibmembran allmählig vorrücke und dadurch sowohl die vordern untauglichen Zähne ersetzt würden, als auch eine Grossenzunahme der Zähne ermöglicht sei, oder man müsste eine von Zeit zu Zeit stattfindende Häutung annehmen; die letzten Annahme scheint mir die natürlichste." Zum fein. Bau d. Molluskenzunge. p. 277.

[2] Anat. e fisiol. della *Spurilla Neapolitana*. Estrat. d. Serie III, Tomo IX, d. Mem. dell' Acad. delle Scienze dell' Instituto di Bologna, 2 Febbriao 1878.

lium of the radula. These cells do not form the basal membrane directly. It is formed from the many-layered epithelium of the radula. It is not formed, as one would suppose, by a cuticular secretion of the cells, but at the cost of the cells themselves. The upper layers of the epithelium of the radula coalesce, and thus form the basal membrane. In this manner the epithelium gradually decreases in thickness as it passes forward. Trinchese says, regarding the formation of the radula, that: "The superior part of the body of each shell is divided into many small rods, which are very small at first and which gradually lengthen as they proceed downwards. These small rods are the denticles. The inferior part of the cell, which takes no part in the formation of the tooth, forms with the similar part of the neighboring cell, the tooth-mass or the true body of the tooth. Finally the boundary between the different cells disappears. The nuclei of the tooth-forming cells which remain under the tooth undergo division and give origin to a very compact layer of nuclei, which become more and more pointed as the tooth is shoved forward, are gradually formed in the matrix. When the teeth are so far protruded from the sheath (odontophore), the inferior part of the tooth forms, by means of the layer of nuclei, a very resisting cuticle. This cuticle thickens as the tooth advances, while the nuclei or cell-layer gradually diminish in thickness." [1]

The little rods that he speaks of are not to be found in *Helix aperta*. As the form of the tongue and the radula is as different in *Helix*, and further as the tongue-papilla, in the true sense of

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[1] "La parte superiore del corpo di ogni cellula, si divide in tanti piccoli bastoncelli, i quali, molto costi in principio, si allungano man mano manzandosi verso il nucleo il quali viene spinto in basso: questi bastoncelli sono i dentini. La porzione inferiore della cellula che non piende parti alla formazione dei dentini, concorre colla porzione omologa delle cellule vicine a formare il corpo del dente. In fine il limito delle diverse cellule scomparisce ed il dente è così formato. I nuclei delle cellule odontogene rimasti sotto il dente, si segmentano e danno origine ad uno stratodi nuclei molto spesso, il quale si va assottigliando a secunda che ildente viene spinto in avanti dagli altri chi si formans via via nella matrice. Quando i denti sono per uscire dalla guaina, in comincia a formarsi sotte di ossi, per l' atturtà dello strato nucleare, una cuticola molto resistente, la quale li fissa solidamente sul margine della rotella. Questa cuticola, a seconda che il dente si spinge in avanti, divene sempre più spessa, mentre lo strato sottostante si assottiglia e si esaurice.

the term, is wanting in *Spurilla*, it is hardly to be supposed that the formation of the radula is exactly the same.

The cells of the matrix lie, in his figure (Tab. VIII, fig. 2 *b*), behind one another, and only the most anterior one comes in contact with the tooth and takes part in its formation. As is easily seen, these relations are very different from the state of affairs in *Helix*.

Rücker,[1] who does not seem to have known of the paper by Trinchese, calls these teeth the ontoginous teeth. He shows five cells to be present, but not arranged in *Helix pomatia* as I have found to be the case with *H. aperta*. His cell *a* takes the place of my *4* and *5*. Over his cell *d* is formed the future tooth. Then "the part of the cell that lies on cell *d*, the future hook, is raised from its bed, and the tooth passes through the arc of a quadrant in order to assume the normal position."[2]

How or by what means the tooth is raised he does not say. I believe, however, that, as I have shown, the death of cell *4* (Pl. X, fig. 5), after the tooth is formed, is a much more plausible explanation.

II.—Observations on the Nervous System.

The nervous system of *Ancylus fluviatilis* was first described by C. Vogt, in 1841, while that of *A. lacustris*, as far as I know, has never yet been especially described. It is, however, formed on the same plan as that of the former species; the difference in the two being merely one of position. Vogt described the œsophageal ring in the following manner: The œsophageal ring consists of two superior, two lateral, and one inferior ganglia.[3] This description is not correct. The part was better described by Moquin-Tandon[4] in the year 1852.

Moquin-Tandon[4] found that the œsophageal ring consisted of seven ganglia: two superior, which he called the cerebral ganglia

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[1] Ueber die Bildung der Radula bei Helix pomatia. Besond. Abdruck aus d. xxii. Bericht d. Oberh. Ges. f. Natur- und Heilkunde, 1883.

[2] Dann "hebt sich der Zelle *d* aufliegende Theil der Zahner, der zukünftige Haken desselben von seiner Unterlage ab, der Zahn beginnt eine vierteldielung, um allmählig aus der übergekippten in die nomaler Stellung überzugehen." Ueb. d. Bildung d. Radula, etc., p. 217.

[3] "Der Schlundring besteht aus zwei obern, zwei seitlichen und einem untern Knoten." Bemerk. u. d. Bau d. Ancylus, etc., p. 29.

[4] Recher. anat. physiol. s. l'Ancyle, etc., p. 129, *et seq.*

(*g. cèrèbroides*), and five inferior (*g. sous-œsophagiens*). Of these latter, two lie laterally (*g. supérieurs*), and two lie below the œsophagus (*g. antero-inferieurs.*) The fifth is an odd one, and is placed between the lateral and the inferior ganglion of the left side, and was called the supplementary ganglion (*g. supplementaire*).

The lateral ganglia are now generally known as the pleural or visceral ganglia, and the inferior the pedal ganglia. In *A. lacustris* the supplementary ganglion lies between the visceral and pedal ganglion of the right side. The reason of this difference of position of the supplementary ganglion is probably that in *A. fluviatilis* the genitals, which are in part supplied by this ganglion, lie on the left side; while in the other form, where the genitals are on the right side, the supplementary ganglion is also on that side.

Further, Moquin-Tandon [1] speaks of two small ganglia, which are joined by *connectives* [2] with the cerebral ganglia, and which he calls the buccal ganglia.

According to Moquin-Tandon, then, the nervous system of *Ancylus* consists of nine ganglia. There exist, however, other ganglia, which Moquin-Tandon did not find. Two of these lie in the tissue of the left mantle of *A. fluviatilis* and in the right of *A. lacustris*. The other two form a pair, and lie in the cephalic portion, at the base of the tentacles, near the position of the eyes.

First we will consider the two ganglia that are situated in the substance of the mantle. They lie in the upper part of the same between one of the windings of the kidney and the musculus cochlearis. These two ganglia are best seen in a horizontal section. They are very small, so that it would be hardly possible to demonstrate their existence by dissection. They are connected by a bundle of nerve-fibres; besides this, there comes a bundle of nerve-fibres from the body to the posterior of these two ganglia. Although I was unable to demonstrate the connection of this

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[1] Recher. anat. physiol. s. l'Ancyle, etc., p. 129, *et seq.*

[2] I use the expression "*connective*," employed by Lacaze-Duthiers (Du Système Nerveux d. Mollus. gastrop. pulmon. aquat. etc. Archiv. d. Zoologie Exp. et Gèn., Tome i, 1872), for those bundles of nerve-fibres which join ganglia of the same side, in opposition to the term "*commissure*," which is only employed to denote those nerve-fibres that join ganglia of opposite sides.

posterior ganglion with the œsophageal ring, I have no doubt of the existence of such a connection.

We will first consider the anterior and largest of these two ganglia. From the form, position and structure I conclude that this is the so-called ganglion olfactorium. The existence of this ganglion was first pointed out by Lacaze-Duthiers [1] in the Pulmonata, but he did not suspect it to be the organ of smell. He supposed it to be the ganglion that provided for respiration, and at the same time regulated the large quantity of mucus which is secreted in the region of the respiratory orifice, the moment the animal is irritated at this point. Spengel,[2] in his researches on this organ in the Prosobranchia, believed it to be the seat of smell, and gave it the name of the ganglion olfactorium.

In *Ancylus* this ganglion lies on that side of the mantle which forms the external wall of the branchial chamber, and almost at the highest point of the chamber, namely, where the gill and mantle join.

The ganglion consists of cells with larger nuclei which are so large that they almost fill out the whole cell. These nuclei take a dark color when stained in picro-carmine, and are filled with a large number of fine granules. No nucleolus was to be seen. The whole ganglion is enveloped in a fine tunica, made up of connective tissue, which is continuous with the tunica that covers the bundle of nerve-fibres connecting the two ganglia.

The form of this ganglion olfactorium is in general spherical. At that point where it comes in contact with the internal surface of the mantle we find an invagination (Pl. X, fig. 6 *inf.*), so that the whole ganglion has a cup-like form. This invagination I call the infundibulum, because it has the form of a funnel. The walls of the infundibulum are lined with cylindrical, cilated epithelium, which seems to be identical to that which covers the inner surface of the mantle, save that the cells and cilia of the infundibulum seem to be a little longer than those of the mantle.

The cells stand perpendicular to the internal surface of the infundibulum, and are separated from the cells of the ganglia by an almost imperceptible tunica of very fine connective tissue. I was unable to determine positively whether there was direct nervous

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[1] Du Syst. New d. Moll. gast., etc.

[2] Die Geruchsorgane und das Nervensystem der Mollusken. Zeitschr. f. wiss. Zoologie, Bd. xxxv, 1881.

connection between the cells of the infundibulum and the ganglion cells, although one undoubtedly exists.

The nerve which connects these two ganglia consists of parallel fibres which are connected with the poles of the ganglion cells. It takes little or no color with picro-carmine, and is quite pale when compared with the surrounding tissues.

The posterior and smaller of these two ganglia I am inclined to believe is the supra-intestinal ganglion, which, according to Spengel,[1] lies in connection with the ganglion olfactorium. It is about one-half the size of this latter ganglion, and lies in the same plane with it, so that a horizontal section through one takes in the other. On one side it lies in contact with the anterior wall of the pericardium; on the other it touches the internal portion of the same part of the kidney which touches the internal portion of the ganglion olfactorium.

This ganglion receives a branch from the body, which is the one probably connecting it with the œsophageal ring. It sends also a branch posteriorly.

The form and structure of this ganglion are similar to that of the ganglion olfactorium, save that there is no funnel-like invagination. This ganglion has all the points that characterize the supra-intestinal ganglion: first, a branch which connects it with the pleural or visceral ganglion; secondly, a branch that connects it with the abdominal ganglion, and thirdly, a connection with the ganglion olfactorium.

The tentacular ganglia.—Besides the ganglia already described as belonging to the central nervous system, together with the ganglion olfactorium, there is a pair of ganglia which do not belong to the central nervous system proper, and may be considered as belonging to the peripheral nervous system. These ganglia have already been pointed out by P. B. Sarasin,[2] as existing in the fresh-water Pulmonata. Sarasin agrees with Lacaze-Duthiers,[3] that this pair of ganglia are homologous to those found in the end of the tentacles of *Helix*. They are situated behind the position of the eye, and in close contact with the

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[1] D. Geruchsorg. u. d. Nervensyst. d. Moll., etc.

[2] Drei Sinnesorgane und die Fussdrüse einiger Gastropoden. Arbeit aus dem Zool. Zootom. Instit. zu Würzburg, Bd. vi, 1883.

[3] Die Syst. Nerv. d. Moll. gast., etc.

epidermis. When the eyes are retracted (for they can be retracted in these animals) they lie close to this pair of ganglia.

In *A. fluviatilis* the eyes and ganglia are seen in the same transverse sections (Pl. X, fig. 8). This is not the case in *A. lacustris*, as the ganglia lie a little posterior to the retracted eyes. Each ganglion of this pair lies at the base of a tentacle, and each is ovoid in shape, the longer axis being antero-posteriorly situated. They are covered with a fine tunica of connective tissue. The nerve that supplies them comes from the cerebral ganglia and enters this ganglion on its inner surface. The nerve-cells which make up the ganglia are in every respect similar to those already described for other ganglia.

The tissue of the ganglia is pierced by a bundle of muscular fibres (Pl. X, fig. 7 *rm*), which comes from the buccal mass, pierces each ganglion and is inserted in that part of the epidermis which is covered by the ganglion. This muscle was not observed by Sarasin.[1] When this muscle contracts, the epidermis, together with the ganglion, is drawn inward.

The figures 7 and 8 (Pl. X) represent two transverse sections through the ganglion of the left side of *A. fluviatilis*. In fig. 7 we see this most anterior of the two sections representing the retractor muscle. Fig. 8 shows the relation of the ganglion to the eye. In these two sections we see that the ganglion has a deep groove on its external surface, so that in fig. 7 we have a figure somewhat resembling that of the ganglion olfactorium (Pl. X, fig. 6 *Go*).

This groove, *f* (Pl. X, fig. 7), is caused by the contraction of the retractor muscle. This groove was always present in sections.

In the figure 7, the nerve (*n*) which comes from the cerebral ganglion is seen entering the ganglion in question. At that point where the ganglion comes in contact with the cells of the epidermis (*p*), they seem to be somewhat longer than those surrounding this part. When the surface of this part is viewed from the exterior a pale patch is seen, which is made up of these lengthened epidermal cells. The external surface of these cells is covered with cilia which are a trifle longer than those found on the adjoining epithelium. Sarasin[2] considers this pair of ganglia as a special organ of sense; I am inclined to believe that we have here an

[1] Drei Sinnesorgane, etc.

[2] Ueber drei Sinnesorgane, etc.

organ similar to the side line, or side organ, that has been found in the annelides by Eisig[1] and Meyer.[2] The ganglion olfactorium may be one of a pair which would represent another segment, the mate of which has been lost by the disturbance of the bilateral symmetry. This so-called ganglion olfactorium is paired in the lowest Gastropoda, as *Patella*, *Haliotis*, etc., when the bilateral symmetry is not as disturbed as in the higher forms of Gastropoda.

The organ of touch.—Moquin-Tandon makes the following observation: "*Ancylus* does not possess an especial organ of touch. The foot, which is large, flexible and capable of being exactly applied to solid bodies, and embraces them in part, it is true, receives and transmits tractile impressions, but the animal rarely uses it for this purpose.

"Blainville has proved that the tentacles of the Gastropoda never serve as organs of touch, in spite of their sensibility; he has merely confirmed the opinion of many earlier naturalists.

"This is not the case with the anterior part of the head, with which the mollusk at times touches different bodies with the appearance of smelling them. I have seen two individuals, which were about to copulate, which had the air of feeling and caressing themselves with the mouth.[3]"

Moquin-Tandon was wrong when he said that no especial organ of touch was present in *Ancylus*, for I have found one without any difficulty. It is probable that Moquin-Tandon was unable to find it, as he did not make any sections of the animal. As would be supposed from the citation, the organ lies in the anterior part of

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[1] Die Seitenorgane und becherförmige Organe der Capitelliden. Mittheil. a. d. Zool. Stat. zu Neapel, Bd. i, 1879.

[2] Zur Anatomie und Histologie von *Polyopthalmus pictus*. Clap., Archiv f. Microscop. Anat., Bd. xxi, 1882.

[3] "L'Ancyle ne possède pas d'organe spécial pour le *toucher active*. Son pied, qui est large, souple et susceptible de s'appliques exactement contre les corps solids, même de les embrasser en partie peut, il est vrai, recevoir et transmettre de impressions tractiles mais l'animal l'emploie rarement à cet usage.

"Blainville à prouvé que les tentacles des gastropodes ne servaient jamais á l'exploration du tact, malgré leur sensibilité; il n'a fait que confirmer l opinion de plusieurs anciens naturalistes. Il n'est pas de même du chaperon et du moufle, avec lesquel le Mollusque touche quelquefois les divers corps et semble les flaiver j'ai ou doux individus disposé à s'accoupler, qui avaient l'air de se palper et de se carresser avec la bouche." – Recher. anat. physiol. s. l'Ancyle, etc, p. 131.

the upper lip, exactly in that part which, according to Moquin-Tandon, was used for feeling.

The position and presence of this organ can best be demonstrated in longitudinal sections of *A. lacustris* (Pl. X, fig. 9), as in this species it is better developed than in *A. fluviatilis*.

This organ is made up of a certain number of specialized epithelial cells, which are connected with the cerebral ganglion by fine nerves; there are two organs which make a pair, and form a patch on each side of the median line of the upper lip, and each is connected with the cerebral ganglion of its own side.

The cells which make up this organ differ principally from the surrounding epidermal cells in their great size (Pl. X, fig. 9 *b-c*). These specialized cells are not all of the same size, those in the centre of the patch being the longer; and as we approach the periphery, they grow smaller and smaller, until they pass imperceptibly into the surrounding epidermis. This can be seen in the drawing (Pl. X, fig. 9), which represents a longitudinal section through the upper lip of *A. lacustris*.

The external or free surface of these cells is covered with long cilia, which thus differ from the cilia of the surrounding epithelium. The nuclei of these cylindrical cells differ from those found in the neighboring epithelium in form as well as in size. When the object is colored in picro-carmine, the nuclei take a deep color, and stand out sharply from the rest of the cell. Although these nuclei are somewhat different among themselves, they are, in general, fusiform. In this respect they differ from the regular, oval-shaped nuclei of the epidermis. Some of these nuclei appear bent, while others are straight. In fig. 9 (Pl. X) we see that some of the nuclei are pointed only at one end, and others at the other, while only one is pointed at both. In reality, all the nuclei are pointed at both ends, and the reason that they are not so in the drawing is that the nuclei have been cut in two, the knife not happening to pass from one point to the other, but to have taken an oblique course. In consequence of this, some represent the one half, and others the other half, of the nucleus. The bending of the nuclei is due, I believe, to action of the re-agents used in preparing the specimen.

The substance of the nuclei is granular, as the other epidermal nuclei, and I could not find the existence of a nucleolus.

The nerve-endings, which enter the cells of this organ, are the

terminal branches of that nerve which arises in the cerebral ganglia, and are distributed to this region of the head. They enter, as near as I could determine, the posterior end of the cell, and become joined to the posterior end of the nucleus. The opposite point of the nucleus approaches the free surface of the cell, and probably is connected in some way with the cilia (Pl. X, fig. 9 *a*). In this figure, the muscular and connective-tissue fibres are intentionally omitted, as it would be difficult to distinguish the nerve-fibres, were they drawn in.

The other organs of special sense in *Ancylus* are so little different from those in other Pulmonata, that I do not consider it necessary to give a description of them here.

III.—The Anatomy of the Excretory Organ.

As yet, no one has completely described the excretory organ of *Ancylus*. This organ has only been known in part, and described under various names. C. Vogt,[1] in the year 1841, spoke of an organ imbedded in the mantle which he called the "sulphur-yellow body" (Schwefelgelber Körper), and supposed that the so-called reticulated portion was the lung.

Moquin-Tandon also considered this organ an organ of respiration, and said: "The breathing organ of *Ancylus* is neither a tube nor an external gill, it is an internal pouch. I am convinced of this, after numerous dissections. This pouch is small, oblong, straight and situated in the left side of the mollusk, toward the border of the mantle, and in advance of the rectum."[2]

Blainville[3] is of the same opinion, and considers that the orifice of this respiratory organ is closed by an opercular appendage (appendice operculaire). This appendage is what I have shown to be the gill.

Moquin-Tandon adds that the orifice is very small. He further speaks of a gland that surrounds the heart, concerning which he says: "The pericardial gland surrounds the heart and the breathing organ, as is the case with most Gastropoda; it occupies

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[1] Bemerk. ü. d. Bau d. Ancylus, etc., p. 28.

[2] *L'organe respiratoire* de *l'Ancyle* n'est, ni un tube trachéiform, ni une branchie externe; c'est une poche intérieure; je m'en suis assuré, après de nombreuses dissections, cette poche est petit, oblongue, etroit, et située à la partie gauche du Mollusque vers le bord du manteau, en avant du rectum. Recher. anat. physiol. s. l'Ancyle, etc, p. 123.

[3] Manuel de malacologie et de conchylogie. Paris, 1825, p. 504.

the left and posterior part of the pulmobranchial pouch, and extends transversely and expands behind the auricle and the ventricle. Its color is yellowish, and opens without doubt at the side of the respiratory orifice."[1] He says further on: "The pericardial gland produces a very large amount of mucus, I have never found calcareous granules in it; these I have only found in the thick part of the mantle, principally near the margin; they were very large, a little irregular and transparent."[2] Although I have diligently searched for the reticulated part described by C. Vogt, I have been unable to find it. It appears to me that he had reference to what I have called the sacular part of the kidney, later to be considered, which lies close to the pericardium, the walls of which have not a reticulated appearance, but are thrown into longitudinal folds. C. Vogt regarded this part of the organ as the lung, while Moquin-Tandon, on the other hand, called it the pericardial gland.

When the animal is laid upon its back, and the mantle and foot separated, an S-shaped yellow body is seen through the thin walls of the mantle.

In *A. fluviatilis* this organ lies in the left, and in *A. lacustris* in the right lobe of the mantle; this is the organ of excretion, or the kidney. Were this organ to be dissected out and measured, it would be found to be about twice the length of the animal to which it belonged; thus in an animal measuring 7·4 mm., the kidney was found to measure 14·4 mm.

In fig. 10 (Pl. X) I have endeavored to give a diagramatical drawing of the course of the kidney. To the largest part I have given the name of the sacular portion; it lies in contact with the

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[1] L'orifice respiratoire est très petit et perce dans un epaississement de la peu, un peu plus pâle que la reste du tissue * * *. La glande pericardiale est accolée comme dans la plupart des Gastropodes, au cœur et à l'organe de la respiration; elle occupe les parties glauches et posterieures de la poche pulmobranche, et s'etend transversalement, en se renflent, derrière l'oreillette et le ventricle. Sa coleur est jaunâtre, s'ouvre sans doute, a côté de l'orifice respiratoire. Recher. anat. physiol. s. l'Ancyle, etc., p. 128.

[2] La glande pericardiale produit une assez grande quantité de mucus. Je n'y ai jamais trouvé de grains calcaires. J'en ai observé seulment dans l'epaisseur du manteau particulierment vero sa marge; ils etaient assez gros, un peu irreguliers et transparents. Recher. anat. physiol. s. l'Ancyle, etc., p. 128.

posterior wall of the pericardium. The folds that I have referred to above are not represented here, as they do not affect the general form of the organ. At the point *b'* the sacular portion passes into the tubular portion. *Os'* represents the opening of the organ into the branchial chamber. The arrow is given to show the position of the animal as regards the kidney, the arrow pointing toward the head. The kidney is drawn as if the observer were viewing it through the external wall of the branchial chamber. The little canal (*t*) which is seen in the anterior part of sacular portion is the communication between the kidney and the pericardium. The diagram (Pl. X, fig. 10 *a*) is drawn from a complete series of transverse sections, by first drawing each section and then projecting it by measurement to surveyor's paper.

The organ may be divided into two parts, which are in form entirely different from one another. The first part—that is, that part which lies next to the pericardium—I call the pericardial or sacular portion (Pl. X, fig. 10 *a*); it is the largest and most active portion of the kidney; it is flattened from the side, so that the greatest diameter is perpendicular to the animal. The walls, as above stated, are thrown into longitudinal folds, which are much deeper at the pericardial end than at the end where this part joins the others; at this point, in fact, it may be said not to exist, as they gradually grow fainter until they disappear altogether. The anterior end of this portion is very broad, and covers nearly the whole posterior wall of the pericardium. This part, which runs obliquely backwards and downwards, has an oval form on transverse section which gradually becomes more circular as the folds disappear and we approach the tubular portion. The length of this first portion, in an average sized animal, is about 2·8 mm.;[1] the greatest diameter, 1·0 mm.; and breadth, 0·3 mm.

In the posterior wall of the pericardium is seen a small funnel-shaped opening (Pl. X, fig. 3 *inf*), which is lined with long cilia; this opening leads into a fine tube; this tube lies in contact with the internal wall of the sacular portion of the kidney for a short distance, and then opens into it. Here we have, without doubt, a direct communication between the pericardium and the kidney.

This small tube may be divided into two parts, histologically different from one another, and the point where this division takes

[1] All measurements are taken from an animal of average size, which measured 7·4 mm. in length.

place is where the rectum, which is on its way perpendicularly through this part of the animal to the gill, comes in contact with the tube. The anterior part of this canal I call the prærectal, and the posterior portion the postrectal.

This little canal has nearly the same calibre throughout; the walls of the prærectal part are composed of cylindrical epithelial cells, which lie on a fine tunica propria, and on the free ends of which are found cilia. The cilia are longest at the pericardial opening of this tube. The lumen of the postrectal part is nearly the same as that of the prærectal part; the walls of the former, however, are somewhat thicker.

The internal surface of the excretory organ is also ciliated, and consists of a layer of cylinder epithelium. In the walls are found those concretions so characteristic of the gastropod kidney. These concretions are not found in the walls all over the kidney, but seem confined to a certain part. It is my opinion that the concretions are identical to those small granulations referred to by Moquin-Tandon (see p. 237) in the mucus of this region.

The sacular portion of the kidney does not pass gradually into the tubular portion, but at a sharp angle, as is seen in the diagram (Pl. X, fig. 10), where a little blind sac is formed (Pl. X, fig. 10 *z*). The diameter of this part of the sacular portion is 0·2 mm.

The second part of the kidney, or the tubular portion, is much longer than the pericardial or sacular portion, but has a much smaller diameter than the latter, and is convoluted. At the beginning it runs parallel with the inferior border of the mantle, and bending at *r* (Pl. X, fig. 10) it returns on its course; at *c′* (fig. 10), it makes another bend and passes for a short distance forward again; then forming a slight curve it passes to its most inferior position, and then running parallel with the lower border of the mantle it opens at *os*, at a position about opposite the posterior part of the gill. In the diagram (fig. 10) I have represented the convolutions as if they were all in one plane; this is, however, not the case, as in a horizontal section we often see two convolutions.

In *A. lacustris* the kidney has essentially the same form, lying in the right mantle, save that the folds of the sacular portion are not so marked.

As to the disposition of the concretion, I can say that they are found in the postrectal and sacular portions, thickly embedded in the walls; the tubular portion, which may be looked upon as the duct to the glandular or sacular portion, also has them in the first part of its course, as far as *o* (Pl. X, fig. 10); they then become scattered and rarer until we get to *c*, when they have entirely disappeared. The whole interior portion of the organ is ciliated.

EXPLANATION OF PLATE X.

FIG. 1. Transverse section, about the middle of *A. fluviatilis*; *s*, shell; *m*, mantle; *mc*, musculus cochlearis; *F*, foot; *qm*, transverse muscular fibres; *L*, liver; *mg*, stomach; *E*, albuminous gland; *D*, intestinal canal; *K*, gill; *exo*, excretory organ or kidney.

FIG. 2. Diagram of buccal mass and odontophore; *m*, mouth; *b*, curved arrow showing direction the food takes to (*oe*) œsophagus; *a*, anterior wall; *c*, arrow showing direction of movement of radula when licking (for *x*, see text); *Od*, odontophore; *r*, radula.

FIG. 3. Part of horizontal section of *A. fluviatilis*; *Inf*, infundibulum; *I* and *ct*, tube connecting kidney (*a*) to pericardium (*P*); *Ht*, heart; *bs*, blood-space; *m*, mantle; *R*, rectum; *mc*, musculus cochlearis; *alb*, albuminous gland; *Go*. parts of genital organs.

FIG. 4 *a*. Horizontal section of odontophore of *A. fluviatilis*.

FIG. 4 *b*. Transverse section of same.

FIG. 5. Posterior part of a longitudinal section of odontophore of *Helix aperta*.

For explanation of the letters of the last three figures, see text.

All the figures, with the exception of fig. 2 and fig. 10 have been drawn by means of a camera lucida

FIG. 6. Transverse section of the ganglion olfactorium (*Go*); *Inf*, infundibulum; *m*, mantle; *d*, kidney; *Brc*, branchial chamber.

FIG. 7 and 8. Two transverse sections of the tentacular ganglion of left side of *A. fluviatilis*; *n*, nerve; *e*, epidermis; *g*, ganglion; *p*, enlarged epidermal cells; *f*, groove; *c*, cutis; *rm*, retractor muscle; *au*, eye.

FIG. 9. Longitudinal section of upper lip of *A. lacustris*. For *a*, see text.

FIG. 10. Diagram of kidney of *A. fluviatilis*. For letters, see text.

The following, received through the Mineralogical and Geological Section, was also ordered to be printed :—

NOTES ON THE GEOLOGY OF CHESTER VALLEY AND VICINITY.

BY THEO. D. RAND.

In a recent reply to criticisms by Dr. Frazer of statements in regard to the serpentine ou'crops, etc., described in Vol. C 6 of the Second Geol. Survey of Pennsylvania, I stated that I would exhibit before the Academy specimens from the outcrops in question. Dr. Frazer stated (*Am. Nat.*, Sept., 1883, p. 525): "At the same time it must not be forgotten that what one observer would regard as evidence of a serpentine outcrop, another would not. * * * It would seem to be only thus that such wide divergencies as are here noted are explicable."

I have here specimens from the serpentine outcrops which I had stated were overlooked in C 6, and specimens from two outcrops represented in C 6 to be serpentine, which I questioned. I think they speak for themselves, but if any member has any doubt or question, I trust the matter may be so discussed as to elicit the truth.

I desire also to call attention to certain statements in the survey of Chester Co., C 4, recently published, statements with which my observations do not agree.

1. The non-existence of Potsdam sandstone, or a sandstone very closely resembling Potsdam, south of Chester Valley.

C 4 says, pp. 34, 124: "The quartzite failed altogether on the southern side of the valley." "No Potsdam sandstone has been detected anywhere along the southern edge of the limestone area."

I have here specimens from Samuel Tyson's, on north flank of South Valley Hill, near King of Prussia station, Chester Valley, and from three localities in Cream Valley (between the South Valley Hill and the Radnor syenitic gneiss range), one, on the Brooks farm, about 100 yards west of the line dividing Delaware county from Montgomery and 300 yards northeast of the southwest corner of Upper Merion township; another, one-half mile west of this, near and south of the limestone on Stacker's place, and the third the Pennsylvania Railroad cut northwest of Wayne station, just north of the trap, in which cut Dr. Frazer, p. 283,

speaks of finding sandy gneiss[1] with a hard serpentine-like mineral. I have also the eurite of Barren Hill for comparison.

It will be seen that the correspondence is exact—the micaceous partings, the rhomboidal cleavage, the minute tourmalines—all agree.

I have also a specimen of the trap of the Conshohocken dyke which crosses this cut about 100 feet southeast of the eurite. I could find no serpentine-like rock there, nor any other hard rock; the rocks are much decomposed, but the gneiss of Rogers' altered primal is there unmistakably.

2. I have also specimens (loose in the soil) from immediately south of the eastern end of the serpentine, stated, on p. 87, to be bounded both south and north by talcose slate. The rock is Rogers' altered primal.

3. On page 87 it is stated: "It is evident that even a synclinal belt of serpentine 2000 feet wide, or even 400 feet wide, can mean nothing else than a great thickness of the talc mica schist formation, metamorphosed more or less completely into serpentine, and a good cause for such alteration is present in an extensive outburst of trap close beyond."

"Everybody familiar with the surface of Delaware and Chester counties knows how *almost invariably* its trap and serpentine appear together."

If this is true, how can it be explained that a few miles further east, what seems to be admitted (p. 282) to be the same serpentine belt is wholly within the gneisses of C 6 (Rogers' altered primal), over 1000 feet south of the trap, with gneiss, hornblende schist, steatite and limestone intervening, and that the trap passes eastward for some five or six miles, at least, from Wayne station, P. R. R., to a point far east of Conshohocken, through the hydromica schists of the South Valley Hill to Bethel Hill without a trace of serpentine.

At what locality in Delaware county, among its numerous serpentine outcrops, does trap, properly so-called, occur?

It does not appear at Lenni, Media, Blue Hill, Marple, Newtown, nor at any of the numerous outcrops of the Lafayette belt, nor of that of the steatite belt on the south, nor of the Radnor belt in Radnor. In Easttown they do appear together, but can

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[1] This quotation is erroneous; in place of "sandy gneiss" it should be "a decomposed friable white gneissoid rock."

this possibly be construed to be more than that converging lines must meet?

4. P. 84: "The southern edge of the South Valley Hill belt of talc mica slates is defined upon the map by a chain of dots and stripes of two colors, representing outcrops of serpentine, and outcrops of crystalline limestone. Were these outcrops ranged in more than one line, the task of explaining their appearance would be far easier. * * * It looks as if the serpentine might be a subsequent modification of the limestone. No case is recorded of the serpentine and crystalline limestone of our line being seen in contact." I do not dispute the last sentence, but the specimens show a variety of rocks in Radnor *between* the serpentine and limestone, which there occupy, as shown on my map, approximatively parallel positions a thousand feet and more apart—conclusive evidence that in that part of the line at least they have no possible connection.

The map in C 4 shows, as clearly as possible on so small a scale, that the line of limestone outcrops is north of the line of serpentine outcrops; all the limestone outcrops shown are west of the west end of the serpentine outcrops.

There is some evidence that this serpentine belt is an altered enstatite.

I show a specimen from near Devon Inn, Easttown township, which seems almost certainly altered enstatite; and specimens of undoubted enstatite from the Lafayette belt, the serpentine of which so strongly resembles that of the Radnor belt, both in structure and accompanying minerals.

5. The statement, p. 282: "The east end of this (the Easttown and Williamstown serpentine belt) continues much further into Montgomery county."

This is certainly an error, caused, perhaps, by confusing this belt with that north of it, as was done in C 6. This belt ceases abruptly on the land of Hon. D. J. Morell, in Radnor township, Delaware county, where the contour suggests the possibility of a fault. The lithological difference of the belts may be seen by the specimens produced. The northerly belt begins on the land of Brooke, about one-fourth mile northwest of the easterly end of the Radnor outcrop, east of Radnor station.

5. On p. 138, a Mr. Morely is quoted, without comment, as stating that the Conshohocken trap follows the *summit* of Bethel

Hill into Delaware county, terminating near the road leading from the Lancaster turnpike to the King of Prussia.

In fact, it is nowhere near the summit, but on the south flank, or at the foot, and so far from ending at the road mentioned, it extends several miles to the westward, its outcrops almost continuous.

7. P. 140: "Near Mr. Hitner's house, Marble Hall, there occurs a thin bed of very ponderous rock, resembling closely a white crystalline limestone. It contains, however, but a moderate proportion of carbonate of lime, and consists chiefly of the carbonate of strontia." Whence there is deduced a bond of connection between the valley limestone and the No. 11 limestone of the valleys of middle Pennsylvania.

Was carbonate of strontia ever found there? Is it not the well-known sulphate of baryta from that locality mistaken for carbonate of strontia?

8. P. 282: "An old quarry close by the Spread Eagle hotel, which is now filled with fragments of trap and rubbish, shows serpentine along with the schistose matter, with a dip about S. 35 E., and seemingly about 35°, etc."

"This quarry is over the line, in Delaware county."

This is an interesting contact. I regret that I have been unable to find it; the only quarry in that vicinity that I can find is about 200 feet west of the Spread Eagle, on the north side of the Lancaster turnpike, nearly opposite Pugh's store; but it contains no serpentine, and is in Rogers' altered primal quarried thence for the turnpike. It was much filled up with trap and rubbish, but has been recently opened again. Old residents assure me that it is the only quarry in Delaware county in that vicinity.

9. P. 282: "As soon as one passes the creek north of Radnor station * * * the measures assume an unctuous, schistose, partly chloritic character."

P. 284: "Fragments of chloritic mica schist."

P. 287: "Willistown, broad conchoidal mica schist, containing much *chlorite* and milk quartz."

Yet Prof. Frazer contends rightly (*Am. Nat.*, October, 1883, p. 1021) that this region contains *hydro-mica* schists only; that the expression "talc mica" is erroneous, as the rocks contain no talc; do they contain chlorite?

Dr. Frazer says (*Am. Nat.*, May, 1883, p. 524): "The observation of the intersection of the serpentine belt by the trap, which

has a more northerly trend in Easttown, is *interesting*, but *not new*." My words were: "A mile southeast of Berwyn, the latter can be seen almost, if not quite, in contact with the serpentine, the trap, however, being on the south of the serpentine. The same is true south of Paoli, except that the trap appears to be on the north side." Prof. Rogers (p. 168) speaks of this trap as "occurring along and outside the northern edge of the serpentine, in a succession of narrow, elongated dykes, ranging more northeast and southwest than the serpentine. These I have not examined, but such structure agrees precisely with what I have observed of the serpentine further east."

This interesting occurrence is not upon the map in C 4; no trap whatever is shown north of the large serpentine outcrop south of Paoli.[1]

Dr. Frazer (*J. Frank. Inst.*, October 1883) kindly compares my criticism with those of the good old gentlemen who, during the war, criticized the army officers, from a safe distance at their comfortable breakfast tables. This is not fair; every observation I have made has been made on the spot and on foot, and in proof of this Dr. Frazer has not pointed out a single error of fact. Had all the observations in C 6 and C 4 been similarly made, many blunders like those of serpentine in the Bryn Mawr cut, in the cut northwest of Wayne, and on the Gulf road north of Matsons' Ford road, would not have appeared.

"But it is not a fact that Rogers' altered primal is a well-defined rock; on the contrary, a more heterogeneous collection of gneiss, mica schists, hydro-mica schists, chlorites, feldspar porphyries, clays and quartz slates than are found in the regions which he colored as altered primal it would be difficult to collect from the two hemispheres."—Dr. Frazer, J. F. I., October, 1883.

I referred to the rock *described* by Rogers. Is it not possible that Dr. Frazer has included, in the above, adjacent rocks which Rogers had no intention of including, as the scale of the map precludes the possibility of accurate mapping; and the rocks mentioned by Dr. Frazer do lie adjacent; but the peculiar rock here shown and so well described by Rogers, is, at least through Lower Merion, Radnor and Easttown, very well defined indeed. Its breadth nowhere exceeds 800 feet, I think, and this on Rogers'

[1] In my review, J. F. I., September, 1883, I inadvertently located this in Easttown. It is really in Willistown.

map would be $\frac{1}{33}$ of an inch; its outcrops are almost continuous, and between, its existence in the fields is constant.

Dr. Frazer attempts a joke founded upon his impression of the absence of an allusion to the serpentine in Radnor and Easttown, in my criticism of C 4. It would have been well for him to have read the paper again. He will find on page 33 an "allusion" to the serpentine in Radnor; on page 34 a map of the outcrops in Radnor and some of those in Easttown.

I did not describe the echelon structure of the serpentine outcrops as a theory, as Dr. Frazer says, but, as a fact, the underground structure I do not attempt to demonstrate. That our observations agree within limits that do not affect the question, is shown in the table given below.

The lines of strike are in part deduced from the dips given by Dr. Frazer, but it may be well to quote from C 4, p. 218: "The serpentine * * * where exposed, it is so fractured and broken as to make the determination of its dip very difficult or altogether impossible. But its strike cannot unfrequently be pursued in almost straight lines for miles."

For this reason, in recording my observations, I preferred to give the dip and strike separately—for the dip varies greatly, the strike does not.

Outcrops.	Strike on map, C 4.	Strike, Frazer, J. F.I. Oct., '83.	90° from Dip. Frazer.	Strike, Rand.	Difference.
1. $\frac{1}{2}$ mile E. of Radnor station.		Nearly E. and W.	N. 70 to 85 E.	Nearly E. and W.	0 to 20°
3. $\frac{1}{3}$ mile N. W. of Radnor station.			N. 70 E. N. 60 W. (? N. 60 E. ?)	N. 60 E.	10° 120° or 0°
6. S. W. of Old Eagle station.	N. 70 E.	± N. 30 E.		N. 40 E.	10°
7. N. W. of and near Devon Inn.				N. 50 to 60 E.	
9. Ivister, S. of Berwyn.	N. 76 E.	N. 40 E.	N. 40 E.	N. 40 E.	0°

A line joining the outcrops 6 and 9 on map C 4 is N. 83 E.
One joining the Radnor outcrops on map by Hopkins, N. 80 E.

Outcrop 3 runs for nearly 1500 feet parallel, or nearly so, to a lane. The bearing of this lane, by surveys recited in the deeds, is N. 62° 40′ E.

Now if the lines of strike given by Dr. Frazer be plotted on the map, it will readily be seen that while a line about N. 83 E. will cross all of them, the strike of all will cross this line at angles from 23° to 43°, except the first. The strike of the outcrops, as given on the map, is wrong, as shown by Dr. Frazer's own figures; but in spite of this the echelon structure is delineated in the two outcrops south and southwest of Old Eagle station, the error—making them two parallel outcrops—being due to the fact that the westerly one is not over 400 feet long, the easterly not over 200, while on the map each is made over 1000 feet long.

Mr. Hall remarks (*Am. Nat.*, June, 1883, p. 647) that I do not account for the absence of slates on the north side of the valley. From the specimens exhibited it will be seen that there are in the North Valley Hill slaty rocks with segregated quartz closely resembling those of the South Valley Hill, though it is true that as a whole the hills are not alike.

I have here specimens to illustrate the succession of rocks north and south of the Radnor gneiss belt.

I would particularly call attention to the rocks immediately south of the Radnor gneiss belt. Their resemblance to those on the north is striking, and it seems worthy of further investigation whether the belt of fine grained gneiss breaking into rhomboidal fragments and connected with a white feldspathic rock, may not be identical with the eurite and adjacent rocks on the north.

I have also two more specimens of the quartzite with supposed fucoidal markings, one of which, from the Old Gulf road east of Bryn Mawr, contains them unusually well defined.

NOVEMBER 6.

The President, Dr. LEIDY, in the chair.

Forty-four persons present.

A paper, entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions. Replies to Criticisms by Mr. Alfred Russel Wallace and Prof. Theodore Gill," by Professor Angelo Heilprin, was presented for publication.

On Visual Organs in Solen.—Dr. BENJAMIN SHARP called attention to a remarkably primitive form of visual organ that he had discovered in the siphon of *Solen ensis* and *S. vagina* (the common "razor-shell").

His attention was directed to the probable possession of visual organs by observing a number of these animals which were exposed in large basins for sale at Naples. A shadow cast by his hand caused the extended siphons of the specimens on which the shadow fell, instantly to retract, while those not in the shadow remained extended. Repeating this experiment at the Zoological Station at Naples, and being fully convinced that the retraction was due to the shadow and not to a slight jar which might have been the cause; he was led to examine the siphon more closely, and he also made a series of vertical sections for the purpose of very minute study.

When the siphon of a large *Solen* is cut open and examined, a number of fine blackish brown lines or fine grooves are seen. These are situated between and at the base of the short tentacular processes of the external edge of the siphon. As many as fifty of these little grooves were found to be present in some specimens, and some of them were from 1 to 1·5 mm. in length.

When a vertical section is examined these pigmented grooves are distinctly seen, and the cells of which they are composed are very different from the ordinary epithelial cells which cover the more pigmented parts. These latter cells are ordinary columnar epithelial cells with a large nucleus which is situated near the *tunica* on which it rests. The pigmented cells are from one-third to one-half longer than those just described, and consist of three distinct parts. The upper part, or that part farthest from the *tunica*, appears perfectly transparent and takes up about one-ninth or one-tenth of the total length of the cell; this part is not at all affected with the coloring matter which was used in coloring the whole. The second part of the cell is deeply pigmented and consequently opaque; it is filled with a dark brown or almost black granulated pigment; this takes up about one-half of the length of the cell. Below this is the third part of this cell, consisting of

a clear mass, which takes a slight tinge when colored; this is probably the most active part of the cell; in this is imbedded the large oval nucleus. This nucleus is sharply demarcated and is filled with a granulated matter which takes a dark color in borax carmine, as do, indeed, the nuclei of all the epidermal cells.

These *retinal cells*, if they may be so called, are similar to those described by P. Fraisse in 1881 (Zeitschr. f. wiss. Zool., Bd. xxv), in the very primitive eye of *Patella cœrulea*, the principal difference being that in *Patella* the transparent part at the top of the cell seems to be a little more extensive. This eye of *Patella* is open, being merely an invaginated part of the epidermis, and has no lense. In *Haliotis tuberculata* we find an open eye also, but with the addition of a very primitive lense. The next higher grade of eye seems to be that of *Fissurella rosea*, in which the eye is closed and possesses also a lense; now in these two lat'er forms, where we find a lense present, the retinal cells do not possess the transparent ends as we find in *Patella* and *Solen*, but the pigment fills the upper part of the cell quite to the top. This would indicate, he thinks, that the transparent part took the place of a lense.

No special nerve-fibres could be detected passing to these pigmented grooves. Nerves passing to the eye of *Patella* were also wanting, while, on the other hand, distinct veins were found passing to the eye of *Haliotis* and *Fissurella*.

He further stated that this power of distinguishing a shadow would be of great use to the animal in the struggle for existence. The *Solen* lies buried perpendicularly in the sand and allows the siphon to project a little above the surface. This projecting part would, probably, frequently be bitten off by fishes, were it not for the fact that the shadow of the enemy would give warning, so that the siphon could be withdrawn in time to save it from destruction.

Notes on Glaciers in Alaska.—Mr. THOMAS MEEHAN remarked that on his recent visit to Alaska he noted that the numerous icebergs coursing down Glacier Bay, always pursued their swift downward course towards the Pacific Ocean quite independently of the rising or falling of the tide. On reflection it was evident that this might be due to the greater density of the cold glacier water pressing on towards the lighter water in the Japan Sea, which set its force against the Alaskan shores. It was, indeed, incorrect to speak of a warm current flowing northwards in any active sense. Warm water never flowed or circulated because it was warm, but it flowed under the simple laws of gravitation—the heavier body pushing the lighter out of its place, and the lighter then being drawn backwards to the vacuum caused by the movement of the weightier volume. The flow of a warm current in the atmosphere or in the water must, therefore, be taken in a passive and not in an active sense; and it was, therefore, to the

immense ice-fields of Alaska themselves that we have to look for the singularly moderate climate of southeastern Alaska, rather than to the mere action of heated water alone. They furnish the heavy power which draws the warm current to its shores. With the disappearance of these huge glaciers, or the diversion of the immense volume of cold water to another channel, the cold of this portion of Alaska would probably be as intense as that experienced along its northern coast. The distinction was one of vast importance, and he ventured an opinion that much of the disappointment often experienced in Arctic navigation arose from overlooking it, and in regarding the warm current as the active agent in circulation.

In examining the Davidson, the Muir, and other glaciers, it also occurred to him that there were active agencies at work, overlooked by those who had made specialties of glacial study. Beneath the Muir glacier, which was said by various authorities to be about four hundred miles long, a large volume of water was flowing in a rapid torrent—this volume, on a carefully considered guess, being about one hundred feet wide with an average depth of four feet. According to information from a white man who had long lived with the Indians of this section, this subglacial river was flowing in about the same volume, summer and winter. The mouth of this glacier hung over into the sea, and formed icebergs in three different modes. Sometimes the edge of the glacier would, in its thinner sections, float over and be lifted off by the rise and fall of the tide; at other times huge masses would break off by their own weight; and at other times the upper edges, which, by the action of running surface water, would be worn into all sorts of rough forms, would topple over, rubbing their faces against the more solid ice, and making a sound which reverberated through the ranges of hills like peals of artillery, and which could be heard many miles away. There were thousands of smaller icebergs floating down Glacier Bay, the most of these evidently formed by the latter mode. It was not safe for the vessel on which he made the visit to approach nearer than a quarter of a mile to the face of this glacier, where it anchored for a day in order to make the examination; but it was near enough, especially with the aid of the ship's boats and good field-glasses, to make excellent observations. So far as could be ascertained through occasional deep fissures, no water came out from under the face of the glacier to the ocean. The mass of ice was apparently lying flat on a bed of rock, the ice occupying a width of something less than two miles, and estimated to be about 300 feet thick on an average of its whole width. This would, of course, obstruct the run of water directly to the ocean, and thus we had the lateral flow which diverged from the glacier's bed about four miles from its mouth. The Davidson glacier, in Pyramid Harbor, had retreated from the ocean, and by comparing facts observed in tracing a portion of its bed with what was seen in connection with this

torrent from the Muir glacier, it was evident that during a glacier's existence the underflowing river might often become dammed, and the torrent diverted, carrying glacial deposits to sections of country long distances away from the track of the glacier, and through portions of country over which glaciers had never flowed. And there might be immense glacial deposits left by a glacier constantly retreating, and after many subsequent years, by the diversion of the glacial river, a new channel and new remains may be deposited through the mass, even by another distant and distinct glacier. This was actually the case in this instance. This stream had torn its way through immense hills of glacial deposits, many hundreds of feet deep, exposing to view the trunks, still standing erect, of a buried forest, though not a stick of forest-growth, except a few alders and willows, could be seen anywhere in the vicinity, as far as the eye could reach, and suggesting that the original deposit was not made by the existing glacier, the waters of which now tore their way through the huge hills.

The question would now arise as to the source of the water supplying the subglacial river-bed. It would be well to carry some ascertained facts along with us in this examination. An iceberg of more than usual dimensions had got aground in Glacier Bay, and, having one good, fair face, it was found by careful soundings that the vessel could be placed close alongside. At seven and a half fathoms, we were able to hitch on to the great block, the sides of which projected far above our deck. The surface of this berg exhibited, in a small way, all the features of a tract of land: lakes, rapids, waterfalls, hills and valleys; in some places, earth and stones. To-day the course of a water-channel might be in one direction, till a falling piece of ice or earth would block it up, when a source would be opened for a new direction, and the little streams, once started, would form in a short space of time wide and deep chasms. A piece of rock, by its dark color attracting the sun's rays, would sink deep into the berg, while earth, porous and non-conducting, would prevent melting; and thus we would have mounds on the berg where the surroundings, clear of earth, would be melted away. The action of the sun on melting portions of the berg was interesting. The thermometer was but 42°; yet on any side where the sun fell, even at this low temperature, the little streams and rivulets were coursing their way to the great ocean around. But on the northern slopes, there were barely any streams, except such as originated on the sunnier sides. In fact, it was demonstrated that wherever the sun struck on ice, even at a low temperature, the deposition of water occurred. What he had carefully noted on this iceberg he had before noted on high mountain peaks: there would be always some melting from the face of a snow-bank, no matter how low the temperature, where the sun shone fairly on it, and the water would sink to the bottom of this mass. On this iceberg there were clefts and rifts and wells furrowed by

the gathering together of melted water into small pools or lakes, or over where dark stones had sunk by the agency of the sun's warmth; but in no case had the holes or cavities penetrated wholly through the iceberg, except on its thinnest outer edges. The temperature necessary for melting was reduced with the depth, till at length there was not heat enough to melt further. The facts all tended to show that very little water would pass through a glacier by way of its surface. Some may pass over to the sides, and get beneath in that way, but the outer ledges of ice seemed to rest very firmly on the ground, as it necessarily must from its arch-like form, owing to the river beneath and the immense weight pressing on the edges of this arch; only occasionally can water be admitted that way, and scarcely could anywhere the volume so acquired be described as flowing from the side of the main glacier. What becomes of the melting snow on the snow-cap of the glacier, the continual and almost imperceptible meltings under the sun's influence at these heights? A prevailing impression is that glacier-ice is but snow which has become ice by the enormous pressure of so thick a body. If this be so, water thawed out from the snow by the sun's rays could not percolate far below the surface of the snow, and there seems no way left to account for the river beneath. If this be not so, then the way would be clear. With no ice below the snow, with the thermometer at the ground above the freezing-point, through the natural warmth of the earth protected by the snow-cap from escaping, the percolating water would descend to the surface of the mountain-top, part entering to furnish fountain-heads for springs and underground streams, running often hundreds of miles away, and the balance running down under the ice-channel formed by the glacier.

It seems such a fair assumption that this may be so, that it is worth while to consider the evidence offered for the belief that glacier-ice is snow under the pressure of its own weight. Snow has been artificially brought under pressure to ice, but such ice is not translucent, as is ordinary crystallized ice. The ice of the Alaska glaciers is remarkably clear, and, when in the proper position against the atmosphere, presents the most lovely cerulean tints imaginable. One of the speaker's pleasantest experiences was a wandering among the wrecks of icebergs strewn all along the shore, in Hoona or Bartlett Bay.[1]

No crystal could possibly be clearer than the fragments strewn everywhere along the beach. The only difference observed between this and the ordinary ice of every-day experience was that, melting in the mouth, it would divide into pieces of the size of peas before wholly uncongealed. Again, from the vessel

[1] At page 187, Proceedings of the Academy, 1883, Hood's Bay was inadvertently used for Hoona Bay. Hood's Bay is some hundred miles south of this point.

anchored a quarter of a mile from the face of the Muir glacier the portion to the southeast for a distance of perhaps a thousand feet, as examined by the field-glass, was of a different character to the rest of the face in having a milky white, marble-like look. The line of demarkation between this opaque and the transparent ice was exactly defined. It was not possible to get nearer for a more satisfactory examination, but the conclusion of all was that this portion was compressed snow. At this point the ice-sea had to draw in, through passing an intruding bluff of rocks, and the lateral pressure must have been enormous between the bluff and the solid ice. It would be the best possible opportunity for a mass of snow, carried down from the mountain side, and floated along on the margin of a wide glacier, to become ice if pressure would ever do it. It cannot, of course, be positively stated that this opaque section was compressed snow, in the absence of actual handling, but there is little room for doubt that it was. It was, at any rate, an opaque section, and wholly different from the glacier-ice as generally seen. Again, from the amount of air-cavities in snow, and the resistance these must offer to the self-pressure of snow, and also from actual experience of deep snow-drifts in ordinary mountain ranges, there is nothing to warrant a belief, outside of an actual demonstration, that the pressure of any depth of snow is of itself sufficient to turn it into glacier-ice.

If now we admit that above the glacial snow-line and under the great snow-cap there may not be solid ice formed by compression, but there may be a huge lake of water held back by the icy breast-work at the snow's edge, we may conceive of a method of forming the glacial sea quite different from any already proposed. The water must and will flow out from the edge of the snow-line when the temperature is far below freezing-point, and form a fringe of ice all along the line. How this is done can be readily seen passing under the snow-sheds of a mountain railroad.

On the Denver and Rio Grande Railroad, passing over Marshall's Pass, 14,000 feet altitude, as the speaker did in May of the present year, the melted snow passed as water through the mass to the bottom, then passed down the mountain-side under the snow to the snow-shed, where it formed real glaciers down the railroad—cutting under the sheds to the railway track. The law must of necessity be the same on a mountain-top in Alaska as on a mountain-top in the Rocky Mountain region. Snow occurring after this icy deposit was formed, would extend down the mountain over the ice, and new layers of ice would be continually forming over the old layers, or on their edges with the occasional retrocession of the snow. A portion of the water at the snow-head will naturally course under the ice, and form a channel beneath. This will increase in width and depth with time. In the torrent which sprung out from above the mouth of the Muir glacier myriads of stones, some of them of many cubic feet in size, were borne along by the muddy waters. The force of the water, as well as the added

force of the rolling stones against the roofs of the glaciers, must have some influence on its descent, as also would the weight of water under the snow forming the cap, pressing against it at the highest point of the glacial departure. The roof of the glacier above the torrent would possibly get worn away somewhat by the friction of the torrent; but as ice is now known to be ductile, it would bend down towards the water when any great hollowing out occurred, and get aid in its downward flow. We may further imagine that under such an explanation as this, the edges of the glacier would have much more of excoriating power, than when the whole mass is spread equally over a wide rocky bed.

In regard to the existence of the glaciers, Mr. Meehan observed that in many instances there were evidences of rapid retreat. Davidson's glacier, at the head of Pyramid Harbor, near the mouth of the Chilkat River, in about lat. 59°, had fallen back several miles from the water in the bay. Having but little more than half a day on shore at this point, an effort to reach the mouth of the glacier failed through taking a "short cut" through a forest of alder and spruce, the undergrowth of the spiny *Pana horrida* being almost impassable. But field-glass observation from the vessel, together with the examination of the track of the retreating ice, showed successive terraces of moraine material, with succeeding generations of trees on them in the supposed distance of three miles from the sea to the glacier's mouth. Near the glacier the trees appeared to be about twenty or twenty-five years old; nearer the sea, from seventy-five to one hundred. But here, as in the Muir glacier, there were evidences of frequent advances and of retrocession in the glacial material. Trees which from their size may have been from thirty to fifty years of age, would have a deposit of twenty or thirty feet of material placed around them, half burying them, and then again have it all cleared away, leaving the dead trunks to tell the story.

The volume of water now flowing in the line vacated by the glacier, is not near equal to the work which has been done in former times; and the less quantity with the retreat of the glacier itself, while other glaciers not fifty miles away still continue their connection with the water, shows that local causes may be at work which may either retard or accelerate a glacier's progress. As already noted, the warmth of the atmosphere near a glacier's mouth will, in a great measure, depend on the volume of cold water projected into the ocean—the greater the volume, the more influence on the warm current which must be drawn in to take its place; and this is as true of the atmosphere as of the water. The heavy cold body pushes the higher warmed air upwards, which has to take the place of the air which rolls forward towards the lightened spot. Hence the greater the volume of cold air departing, the larger and stronger the current of lighter and warmer air which returns to the source of motion, so the temperature is not low in the vicinity of the glaciers. On the iceberg before described, the

thermometer indicated 42°; but a quarter of a mile from the immense body forming the mouth of the Muir glacier, the temperature was 60°. These warm currents, however, vary with the drafts through the mountains. Within comparatively short distances, the temperature would vary from between 40° and 60° at the time referred to. In the winter season the difference would be the more remarkable, and hence a mountain or glacier torrent, cutting out for itself a new channel, and making a deep rift in a mountain, would originate a new current—warmer or colder, as the case might be—which must have an influence on the progress or decrease of the glacier itself. The operations of these changes in the atmospheric currents were very evident in the vicinity of the Davidson glacier. Sometimes through chasms in the mountains near, the whole mass of timber on either side would be quite dead after having made a successful stand for from twenty-five to fifty years, by the work of some severe cold current, which, by some local change, had found its way along the course. Near by, on land no better, quite as steep, and in no way more favorable to the growth of vegetation, the timber would be perfectly healthy, the only difference being in the freedom from the atmospheric current that had destroyed the others. In short, the age of the trees on the successive terraces left by the waters along the line of the glacier's retreat, showed how much had been done within a comparatively recent period, and other attending facts showed that local causes, induced by the glacier itself, may rapidly retard or accelerate its development at various periods in its existence.

In the retreat of the glaciers, in this part of Alaska, an alder, *Alnus viridis*, was apparently the first arborescent plant to establish itself. Large tracts of the drift would be wholly covered by a dense, bushy growth. In time, however, many of these would advance to the dimensions of large timber-trees, surprising to those who might have only seen them as eight- or ten-feet bushes in other parts of the United States In the woods bordering on the Davidson glacier, the speaker saw Indians at work making canoes (dug-outs) from the trunks of this alder.

Favorable Influence of Climate on Vegetation in Alaska.—In his remarks on glaciers in Alaska, Mr. THOMAS MEEHAN observed that on the tops of what are known as "totem-poles" in some of the Indian villages, trees of very large size would often be seen growing. These poles are thick logs of hemlock or spruce, set up before the doors of Indian lodges, carved all over with queer characters representing living creatures of every description, and which are supposed to be genealogies, or to tell of some famous event in the family history. They are not erected by Indians now, and it is difficult to get any connected accounts of what they really tell. At the old village of Kaigan there are numbers of poles erected, with no carving at all on them, among many which are wholly covered, and these all had one or more

trees of *Abies Sitkensis* growing on them. One tree must have been about twenty years old, and was half as tall as the pole on which it was growing. The pole may have been twenty feet high. The roots had descended the whole length of the poles, and had gone into the ground, from which the larger trees now derived nourishment. In one case, the root had grown so large as to split the thick pole on one side from the bottom to the top, and this root projected, along the whole length to the ground, about two inches beyond the outer circumference of the pole. Only in an atmosphere surcharged with moisture could a seed sprout on the top of a pole, twenty feet from the ground, and continue for years to grow almost or quite as well as if it were in the ground.

We may also understand by incidents like these how tree-life endured so very long in this part of Alaska, and why rocky acclivities, on which no vegetation at all could exist in the dry climate of the eastern States, were here clothed with a luxuriant fresh growth, so thick that it was almost impossible for one to make a journey through it. Indians had very few trails; most of their journeys were by canoes. At this village he also saw a bush of *Lonicera involucrata*, which was of immense size, as compared with what he had seen in Colorado and other places. This was at the back of an Indian lodge and alongside of a pathway, cut against the hill-side. The plant was growing on the bank and grew up some ten or twelve feet, where it bent over, apparently of its own accord, and rested on the roof of the lodge, its numerous branches making a dense arbor under which the road passed. The stems near the ground were, some of them, as thick as his arm, and the whole plant was covered by very large black berries. Stopping in admiration to look at and examine the specimen, brought numbers of Indians to see what was the subject, who smiled pleasantly on being made to understand that only the sight of a huge bush had attracted the traveler. Subsequently another specimen was noted in the woods on a plant of the native hemlock, *Abies Mertensiana*. In the woods the plant is somewhat sarmentaceous. It could not climb a hemlock without assistance. This old hemlock was bereft of branches to about twenty feet high, but the *Lonicera* was above the lower branches, and had journeyed along them to the extremities, beyond which it was beautifully in fruit. It could only have been there by growing up with the hemlock when that tree was young, and was probably of about the same age. The Indian village of Kaigan is not properly in Alaska, but just over the border in British Columbia, at the southeastern point of Alaska, but the climatic conditions are about the same.

The following was ordered to be printed:—

NOTES ON GLACIAL ACTION IN NORTHERN NEW YORK AND CANADA.

BY JOSEPH WILLCOX.

In a former communication I have noted some results from glacial action in northern New York and Canada. I have recently observed some other matters connected with the same action, in that region, viz., in Lewis, Jefferson and St. Lawrence Counties in New York, and in Canada, for a distance of one hundred and twenty-five miles north of the St. Lawrence River.

In this territory all the original soil appears to have been removed by glacial action, and that which now remains there has been deposited by the receding glacier. It is thinly distributed, seldom being many feet in depth; while, in many cases, the rocks have no soil upon them. All the rocks are extensively eroded, and those which are durable still remain smooth—both above the ground and underneath—wherever I have seen the soil removed.

In the country south of the great terminal moraine, which extends across our continent, the soil is usually deep, especially in our Southern States. The top of the rocks, under this deep soil, is ordinarily in a state of disintegration; and the different stages of transition from hard rock to soil may easily be observed. Loose stones, on top of and in the soil, are more or less decomposed on their surface, relinquishing their substance slowly, as new virgin soil, for the needs of vegetation. Where the country has been extensively glaciated, this condition of the rocks and stones does not exist, the soft portion of them having been removed by attrition, and, since the glacial times, little disintegration of the surface of the granite and Pottsdam sandstone has occurred.

If the great ice sheet should have receded north speedily, by rapid melting, less material would, of course, be deposited on the ground, than in the case of a slow retrogression. In the former case little would be deposited, in any locality, except what was already on the ground, in the process of transportation.

Taking the country north of Philadelphia as illustrating probably the conditions prevailing elsewhere within the glaciated area, I have observed that north of the great terminal moraine a large

amount of silt has been deposited, as moraine material, by the receding glacier, as far north as Trenton Falls, in New York, but not much farther. On the north side of the Mohawk Valley, from Utica to Schenectady, vast deposits of glacial drift may be seen. North of Trenton Falls the deposits appear to diminish rapidly in quantity, so that I observed no large accumulations near the St. Lawrence River or north of it. The farther north I proceeded the smaller the deposits appeared to be, including the ordinary surface soil.

From the above facts I consider there are reasonable grounds for suspecting that the glacier receded slowly from Pennsylvania until its southern limit was not far north of the Mohawk River, and then it was withdrawn more rapidly, with increasing speed, as it proceeded north.

Some geologists consider that there was not a great amount of glacial erosion accomplished upon the rocks in Pennsylvania. I believe that the erosion proceeded with much greater effect in Canada than in this State. While progressing from the north the glacier would operate on the rocky surface of Canada during a long time before it would reach the latitude of Pennsylvania. Also during its decline it would still continue its abrasion in Canada long after it had retreated from our State.

I have observed, in northern New York and Canada, that where the country is level it is often covered with Silurian limestones or sandstones, but where it is hilly the Laurentian rocks usually prevail. In the latter case the Silurian rocks may have formerly existed and been removed, as they were more effectually exposed to the glacial erosion.

Many sharp, angular stones are scattered over the ground in Canada among the rounded boulders. These evidently have not been transported far from the parent rock, but they are suggestive of the fact that, even near the close of the glacier's career, rocks were still being torn into fragments. These fragments were chiefly broken loose from the southwestern portions of the rocks.

As a shallow soil prevails in the district referred to, the trees do not obtain a deep, substantial hold upon the ground; consequently they are easily blown down by the storms, and the forests are filled with prostrate trees, which make travel a difficult operation there. When the forests are cleared off, the ground is in a

very rough condition. A hole in the ground indicates the place where a tree formerly stood, while a pile of earth alongside denotes the place where the roots of the prostrated tree transported and deposited the soil that was in the hole. Large fields may be seen, the surfaces of which are almost wholly broken up into holes and piles of earth, by the prostration of trees.

NOVEMBER 13.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

The following was ordered to be published:—

OBITUARY NOTICE OF CHARLES F. PARKER.

BY ISAAC C. MARTINDALE.

When a man has given to the service of the public good the best years of his life, and that life perhaps shortened in consequence of his devotion and faithfulness to known duties, it should rest with some survivor to so place upon the historic page this record, that perchance some disconsolate and weary follower, ready to faint by the way, "seeing may take heart again." For such a life is a conspicuous mark on the highway of honest endeavor, and a beacon light ever before the devoted inquirer after truth.

Hence I have assumed to place herein a notice of the life and services of Charles F. Parker, late Curator-in-charge of this Academy.

His parents resided in Philadelphia, where he was born on the 9th day of November, 1820. His mother dying when he was but an infant, he was deprived of a mother's love to stimulate and encourage him in his undertakings.

His father, being in humble circumstances, was able to give him but a limited education. Charles, as soon as he was old enough to be of any service, was apprenticed to bookbinding; his father having long been engaged in that business.

He remained in Philadelphia until about the age of 22 years, when he went to Boston and engaged in the same business. After residing there about two years he married Martha Kellom, and in 1851 left Boston and moved to Leominster, where he opened a book-store, and carried on bookbinding on his own account. This business enterprise, not being so successful as he had hoped, was abandoned in 1853, and he removed to Camden, New Jersey, where he resided during the remainder of his life.

About two years after the death of his mother, his father married again, and when the father died in 1835, his widow continued to carry on the bookbinding, and Charles became a partner and assumed the management of the business, subsequently conducting the woik on his own account.

As a business man he was extremely conscientious in having his work performed at the exact time that had been agreed upon; and he attained an enviable reputation as a neat workman—to such an extent, that services in his business which required the utmost care and nicety were sure to be sent to him to be performed, and he would not undertake any kind of work that was expected to be done in a cheap or hurried manner. Having the oversight and employment of others for many years, his just treatment of them always gave him the choice of the best workmen, and those who were satisfactory remained year after year in his employ.

During the earlier part of his life he did not manifest any especial interest in natural history; yet for a long time he was a companion of C. S. Rafinesque, the well-known naturalist, who boarded in the same house. This was during the latter part of the life of Rafinesque, when he was engaged in the manufacture of medicines, which he contended were for the relief of "all the ills that flesh is heir to." The writer has repeatedly heard narrated some of the incidents in the life of this naturalist which occurred during those years, and which seemed to have made a lasting impression on the mind of our friend C. F. Parker; so much so that I am led to believe the love for natural science, which developed in the later years of his life, was from some of the seed then sown. One of these incidents, so characteristic of the eccentric Rafinesque, may be mentioned here: Charles was quite fond of remaining in bed at a later hour in the morning than usual when he was not expected to be at his place of business, and often entertained himself by singing some favorite tune; on one such occasion Rafinesque heard the usual melodious sounds, and went to the room door, which he quickly opened, exclaiming,

> "He who sings in bed instead of sleeping,
> And whistles at the table instead of eating,
> Is either crazy or soon will be."

Having thus relieved his mind, he went away to his own quiet

musings, which he did not seek to brighten by such displays of levity or cheer.

Very soon after making Camden his home, Charles became interested in conchology, although he had never seen a collection of shells, nor known anything of their scientific arrangement or method of study; neither was he acquainted with any one at work in that department of natural history. His attention also became directed towards insects, especially butterflies and beetles, and learning that a society had been formed for their study, he applied for membership in the Entomological Society of Philadelphia, and was elected November 11, 1861.

This brought him in contact with men of science, and gave him an opportunity to examine books and specimens that he had never known of before, opening a new life and infusing a zeal which increased with advancing years.

The study of conchology and entomology opened the way for other branches of natural history; and having become a frequent visitor at this Academy, he was brought into intimate relations with several of its members who were pursuing the study of botany and making collections of plants in the immediate neighborhood of Philadelphia. He soon became interested with them in their pursuits, and took up the same study with especial zeal. Withal, he never neglected his business, nor failed to keep his appointments and engagements therein. He was elected to membership in the Academy on the 29th of August, 1865, and forthwith entered heartily into work, for it will be remembered that at this time the collections were not well arranged, owing to the limited space occupied, and the want of means to secure the services of competent workmen; so that almost all of the labor performed was voluntary and gratuitous.

His earliest labors in the Academy were directed to the conchological collection, and for seven years he devoted a large portion of the time that could be spared from his business to its systematic arrangement, preparing and mounting during that period about one hundred thousand specimens, in a style which, for neatness and adaptability for scientific study, has not been excelled. This labor, perhaps the greatest volunteer work ever done in the Academy, was only finished a short time before it became necessary to pack the Academy's museum for removal to the present building; he immediately engaged in this labor, and

had already devoted much time to it, when it became apparent to his fellow-members that the Academy would be greatly benefited by employing him permanently for a compensation. In 1874 he was elected one of the Curators, and on solicitation was induced to partially give up his business as a bookbinder and accept the meagre amount which the Society could afford to pay him, giving in return the greater part of his time to its work. The entire museum was removed under his direction and arranged in cases in this building in a very short period—the actual removal being accomplished in about a month, the unpacking and display in the cases in about five months. He has been annually re-elected one of the Curators of the Academy at successive elections, invariably receiving the full number of votes cast, however many candidates were in nomination, thus showing the value and appreciation of his services.

Although he continued his interest in the study of conchology and entomology, and made quite extensive collections in both of these departments, he seemed to have taken an especial fondness for the study of botany, which he never afterward allowed to falter. He was one of the first to discover that the ballast deposits in and around Philadelphia and Camden were prolific in introduced plants, and his knowledge of conchology sometimes enabled him to determine the part of the world from which those deposits came, as occasionally fragments of shells were found therein.

In one of his journeyings to the swamps of Cape May County he met Coe F. Austin, the noted cryptogramic botanist, who died at Closter, N. J., a few years ago, and who at that time was engaged in the study of the flora of New Jersey. There at once sprang up a real friendship between them, which increased as time advanced, terminating only when Austin died. The interest, however, which had been created to endeavor to complete a list of the plants of New Jersey was not allowed to abate; and for several years past, in connection with other botanists, the work has been approaching completion to such an extent that a preliminary catalogue has been compiled by N. L. Britton, and printed under the auspices of the Geological Survey of New Jersey, in which the name of C. F. Parker frequently appears. Probably no botanist has made more frequent visits to the pine barrens and swamps of that State, nor collected so extensively

of her flora, as he did; the same ready tact displayed in the work of his hands everywhere has been especially noticeable in the preparation of his herbarium specimens; they are at once characteristic and good, so much so that exchanges were desired from him by the noted botanists of the country, and to-day his specimens enrich many private collections and herbariums of institutions of the United States and Europe. The collection of New Jersey plants which he has left is one of the finest and most perfect that exists, and of itself is a monument of patience and skill of which any one might feel proud.

The annual reports of the officers of the Academy, of late years, show somewhat of the service he has rendered. The mounting of specimens presented, and their arrangement, has been one of great labor, requiring skill, patience and care. The neatness displayed, so characteristic of the man, has made the collections of the Academy of inestimable value to the scientific world and an ornament to the institution itself. Since occupying its present building, between thirty and forty thousand additional specimens of shells have been received, all of which have been mounted by him, and nearly all outside of the hours in which he was employed by the Academy, and without compensation. He was one of the founders of the Conchological Section and of the Botanical Section, and was active in their proceedings.

It has well been said he was a born naturalist; he had a quick eye and good judgment in perceiving and estimating specific characters, and an excellent memory. His knowledge of conchology was probably almost as extensive as his acquirements in botany, although he was, perhaps, more widely known in the latter department. What he knew he was always ready to impart to others, and the many naturalists who have consulted the collections of the Academy during his curatorship invariably received from him valuable and generous aid.

The service which he gave to this Academy, the self-sacrificing devotion to its interests ever manifested by him, proved at last to be the weapon of his own destruction. In the early part of the present year his health rapidly gave way, so that he was obliged to refrain from continuous work. The Council of the Academy, mindful of his eminent services, unanimously granted him leave of absence for the summer months, in order that rest might, if possible, restore his wasted energies and give back

to the Academy his invaluable services; but too late! The disease gradually assumed a more serious character, and at last paralysis of the brain set in, which terminated his life on the seventh day of September, 1883, in the sixty-third year of his age.

My acquaintance with him, extending back nearly a quarter of a century, has given me full opportunity to know his character and judge of his worth. Had he been favored with good opportunities for school education in early years, he doubtless would have ranked among the eminent scientists of the day; yet the record which he has left of overcoming the many obstacles of life, of his rigid adherence to right, his extremely conscientious desire to be found faithful in all his undertakings, and the work of his hands in all the departments in which he found engagement, have given him a record and a name which must ever remain; whilst the memory of his many social qualities well known to me serves to make up the triplicate of naturalist, companion, and friend.

NOVEMBER 20.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

The following were presented for publication:—

"Notes on American Fishes preserved in the Museums at Berlin, London, Paris and Copenhagen," by David S. Jordan.

"The Occident Ant in Dakota," by Rev. H. C. McCook.

"Staining with Hæmatoxylon," by Chas. L. Mitchell, M. D.

The death of John L. LeConte, M. D., a member, was announced.

The following was ordered to be printed:—

ON THE VALUE OF THE "NEARCTIC" AS ONE OF THE PRIMARY ZOOLOGICAL REGIONS. REPLIES TO CRITICISMS BY MR. ALFRED RUSSEL WALLACE AND PROF. THEODORE GILL.

BY PROFESSOR ANGELO HEILPRIN.

The subjoined criticism by Mr. Alfred Russel Wallace on my paper entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions," published in the Proceedings of the Academy for December, 1882, and my reply thereto, appear in *Nature* under dates of March 22 and April 26 of this year:—

"In the *Proceedings of the Academy of Natural Sciences of Philadelphia* (December, 1882), Prof. Angelo Heilprin has an article under the above title in which he seeks to show that the Nearctic and Palæarctic should form one region, for which he proposes the somewhat awkward name 'Triarctic Region,' or the region of the three northern continents. The reasons for this proposal are, that in the chief vertebrate classes the proportion of peculiar forms is less in both the Nearctic and Palæarctic than in any of the other regions; while if these two regions are combined, they will, together, have an amount of peculiarity greater than some of the tropical regions.

"This may be quite true without leading to the conclusion argued for. The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality. The absence of the families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*, *Dipus* and *Hystrix*, among mammals; and of the important families of fly-catchers and starlings, the extreme rarity of larks, the scarcity of warblers, and the absence of such widespread genera as *Acrocephalus*, *Hypolais*, *Ruticilla*, *Saxicola*, *Accentor*, *Garrulus*, *Fringilla*, *Emberiza*, *Motacilla*, *Yunx*, *Cuculus*, *Caprimulgus*, *Perdix*, *Coturnix*, and all the true pheasants, among birds, many of which groups may almost be said to characterize the Old World as compared with the New, must surely be allowed to have great weight in determining this question.

"The geographical individuality of the two regions is of no

less importance, and if we once quit these well-marked and most natural primary divisions we shall, I believe, open up questions as regards the remaining regions which it will not be easy to set at rest. There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions. But even after these two are united, there will remain discrepancies of almost equal amount among the rest, since in some groups the Neotropical, in others the Australian, far exceed all other regions in their specialty. The temperate and cold parts of the globe are necessarily less marked by highly peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate, and have thus not been able to preserve so many ancient and specialized forms as the more uniformly warm areas. But, taking this fact into account, it seems to me that the individuality of the Nearctic and Palæarctic regions is very well marked, and much greater than could have been anticipated; and I do not think that naturalists in general will be induced to give them up by any such arguments as are here brought forward.

"ALFRED R. WALLACE."

Reply to the preceding:—

"Permit me to make a few remarks relative to Mr. Wallace's criticism (*Nature*, vol. xxvii, p. 482) of my paper on 'The Value of the Nearctic as one of the Primary Zoological Regions.' Briefly stated, it is maintained in the early portion of this paper (1) that the Nearctic [1] and Palæarctic faunas taken individually exhibit, in comparison with the other regional faunas (at least the Neotropical, Ethiopian and Australian), a marked absence of *positive* distinguishing characters, a deficiency which in the mammalia extends to families, genera, and species, and one which, in the case of the Nearctic region, also equally (or nearly so) distinguishes the reptilian and amphibian faunas; (2) that this deficiency is principally due to the circumstance that many groups of animals which would otherwise be peculiar to, or very characteristic of, one or other of the regions, are prevented from

[1] In the paper under consideration, I have given what appear to me satisfactory reasons for detaching certain portions of the Southwestern United States from the Nearctic (my Triarctic), and uniting them with the Neotropical region.

being such by reason of their being held in common by the two regions; and (3) that the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other faunas than either the Nearctic or Palæarctic taken individually.

"In reference to these points, Mr. Wallace, while not denying the facts, remarks: 'The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality.' Numerous families and genera from the classes of mammals and birds are then cited as being entirely wanting in the western hemisphere, and which—in many cases almost sufficient to 'characterize the Old World as compared with the New'—'must surely be allowed to have great weight in determining this question.' No one can deny that the absence from a given region of certain widespread groups of animals is a factor of very considerable importance in determining the zoological relationship of that region, and one that is not likely to be overlooked by any fair-minded investigator of the subject. But the value of this *negative* character afforded by the absence of certain animal groups as distinguishing a given fauna, is in great measure proportional to the extent of the positive character—that furnished by the presence of peculiar groups - and indeed may be said to be entirely dependent on it. No region can be said to be satisfactorily distinguished from another without its possessing both positive and negative distinguishing characters. Mr. Wallace has in his several publications laid considerable stress upon the negative features of the Nearctic fauna as separating it from the Palæarctic or from any other, but he has not, it appears to me, sufficiently emphasized the great lack, *when compared to other faunas*, of the positive element, the consideration of which is the point aimed at in the first portion of my paper, and which has led to the conclusions already stated—that only by uniting the Nearctic and Palæarctic regions do we produce a collective fauna which is broadly distinguished by both positive and negative characters from that of any other region. If, as Mr. Wallace seems to argue, the absence from North America of the 'families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*,

Dipus and *Hystrix*,' be sufficient, as far as the mammalian fauna is concerned, to separate that region from the Palæarctic, could not on nearly equally strong grounds a separation be effected in the Palæarctic region itself? Thus, if we were to consider the western division of the Palæarctic region, or what corresponds to the continent of Europe of geographers, as constituting an independent region of its own, it would be distinguished from the remainder of what now belongs to the Palæarctic region by negative characters probably fully as important as those indicated by Mr. Wallace as separating the Nearctic from the Palæarctic region. The European mammalian fauna would be wholly deficient, or nearly so, in the genera *Equus*, *Moschus*, *Camelus*, *Poephagus*, *Gazella*, *Oryx*, *Addox*, *Saiga*, *Ovis*, *Lagomys*, *Tamias*, in several of the larger *Felidæ*, as the tiger and leopard, and in a host of other forms. A similar selection could be made from the class of birds (among the most striking of these the *Phasianidæ* and *Struthionidæ*), but it is scarcely necessary in this place to enter upon an enumeration of characteristic forms. Divisions of this kind, to be characterized principally or largely by negative faunal features, could be effected in all the regions, and in some instances with probably more reason than in the case under discussion.

"But the question suggests itself, what amount of characters, whether positive or negative, or both, is sufficient to distinguish one regional fauna from another? Mr. Wallace states: 'There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions.' Is it to be inferred from this quotation that Mr. Wallace recognizes no such general equivalence? Is a region holding in its fauna, say from 15 to 20 per cent. of peculiar or highly characteristic forms, to be considered equivalent in value to one where the faunal peculiarity amounts to 60 to 80 per cent.? If there be no equivalence of any kind required, why not give to many of the subregions, as now recognized, the full value of region?

"Surely, on this method of looking at the question, a province could readily be raised to the rank of a full region. In the matter of geographical individuality little need be said, as the circumstance, whether it be or be not so, that the 'temperate and cold parts of the globe are necessarily less marked by highly

peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate,' does not affect the present issue, seeing that the peculiarity is greatly increased by uniting the two regions in question; nor does it directly affect the question of the Nearctic-Palæarctic relationship.

"The second part of my paper deals with the examination of the reptilian and amphibian faunas, and the general conclusion arrived at is: 'That by the community of its mammalian, batrachian and reptilian characters, the Nearctic fauna (excluding therefrom the local faunas of the Sonoran and Lower Californian subregions, which are Neotropical) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæarctic (of which it forms only a lateral extension).' Towards this conclusion, which, it is claimed, is also borne out by the land and fresh-water mollusca and the butterflies among insects, I am now happy to add the further testimony of Mr. Wallace (overlooked when preparing my article) respecting the *Coleoptera* ('Distribution,' 'Encycl. Britann.,' 9th ed., vii, p. 274).

"As regards the name 'Triarctic,' by which I intended to designate the combined Nearctic and Palæarctic regions, and which may or may not be 'somewhat awkward,' I beg to state that, at the suggestion of Prof. Alfred Newton (who, as he informs me, has arrived from a study of the bird faunas at conclusions approximately identical with my own), it has been replaced by 'Holarctic.' In conclusion, I would say that, while the views enunciated in my paper may not meet with general acceptance at the hands of naturalists, it is to be hoped that they will not be rejected because they may 'open up questions as regards the remaining regions which it will not be easy to set at rest.' "ANGELO HEILPRIN.

"*Academy of Natural Sciences, Philadelphia, April 6.*"

In the issue of *Nature* for June 7, Prof. Theodore Gill, in an article entitled "The Northern Zoogeographical Regions," submits the following criticisms on my paper supplementary to those of Mr. Wallace:—

"The facts of zoogeography are so involved, and often apparently contradictory, that a skilful dialectician with the requisite knowledge can make a plausible argument for antithetical postu-

lates. Prof. Heilprin being a skilful dialectician and well informed, has submitted a pretty argument in favor of the union of the North American or 'Nearctic' and Eurasiatic or 'Palæarctic' regions (*Proc. Acad. Nat. Sci. Phil.*, 1882, pp. 316–334, and *Nature*, vol. xxvii, p. 606), but Mr. Wallace has, with perfect justness it seems to me, objected to his proposition (*Nature*, vol. xxvii, pp. 482, 483). As Prof. Heilprin's arguments have not been entirely met, however, permit me to submit some further objections to his views.

"Prof. Heilprin has contended '(1) that by family, generic, and specific characters, as far as the mammalia are concerned, the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other regions than either the Nearctic or Palæarctic taken individually; and (2) that by the community of family, generic and specific characters the Nearctic region is indisputably united to the Palæarctic, of which it forms a lateral extension.'

"Prof. Heilprin has formulated these conclusions after a summary of the families and genera common and peculiar to the regions in question.

"As to families Prof. Heilprin has presented the following figures:—

	All.	Peculiar.
Nearctic,	26	1
Palæarctic,	36	0
Oriental,	36	3
Australian,	22	8
Ethiopian,	44	9
Neotropical,	31	8

"The proportions of peculiar genera to the entire mammalian faunas of the several regions are stated to be as follows:—

	All.	Peculiar.	Percentage.
Nearctic,	74	26	35
Palæarctic,	100	35	35
Oriental,	118	54	46
Australian,	70	45	64
Ethiopian,	142	90	63
Neotropical,	131	103	78

"The question may naturally recur, why the line which sep-

arates 'regions' from 'subregions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606).

"But an analysis of more (but only approximately) correct figures and a more logical classification of mammals than that adopted by Prof. Heilprin reveal factors materially contravening the tabular statements of that gentleman.

"First we must exclude the marine mammals, because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones. A consideration then of the terrestrial forms leads to the following results:—

"The Arctamerican or Nearctic region has twenty-seven families, of which eleven are not shared with Eurasia and four are peculiar; it has sixty-eight genera, of which forty-five do not enter into Eurasia.

"The Eurasiatic or Palæarctic region has thirty-two[1] families, of which seventeen are excluded from North America, and it possesses eighty-nine[1] genera, of which sixty have failed to become developed in America.

"Such contrasts will more than compare generally with those existing between Eurasia and India, and even between the 'Triarctic' or 'Holarctic' and Indian 'regions,' and the same destructive process by which the northern regions are abrogated would entail the absorption of the Indian as well into a heterogeneous whole. The three can in fact be well united (as Cænogæa), and contrasted with a group (Eogæa) consisting of the African, South American, and Australian regions, as I long ago urged (*Ann. and Mag. Nat. Hist.* [4], xv, 251–255, 1875), but the claims of each to be considered as 'regions' or realms are not thereby affected. "Theo. Gill.

"*Smithsonian Institution, Washington, May* 12."

The above criticisms of Prof. Gill fall into two distinct categories, which may be conveniently formulated as follows:—

[1] These are the groups admitted by Prof. Heilprin, exclusive of the Pinnipeds.

1. Accepting the data as given, are the conclusions drawn from them necessarily correct?

2. Are the data themselves correct?

The first of the questions is answered by a negative in interrogation, if so it may be termed. Prof. Gill objects to my (?) method of distinguishing between the larger and smaller zoogeographical divisions, and pointingly submits that "The question may naturally recur, why the line which separates 'regions' from 'sub-regions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606)." The problem here stated is certainly one that does not admit of a ready logical solution, and one which the writer has never attempted to solve; nor, as far as he is aware, has its solution ever been effected by any other writer on zoogeography. 78 is indisputably as near to 64 as this last is to 46, and but little less near than 46 is to 35; and if one or two more terms be added to the series, it may still be contended with equal justice that 46 holds approximately the same relation (in this sense) to 35 as 35 does to 25, and 25 to 15 as 15 to 5, and so to either end. So far, well and good. But the fact still remains, nevertheless, that a region whose fauna is characterized by 90 or 78 per cent. of peculiarities is *eminently* well defined from any and all other regions; that one whose peculiarities amount to 64 or 46 per cent. is *considerably less* well-defined; and that another, where the peculiarity amounts to only 15 or 10 per cent., is still less well-defined, and, in fact, scarcely defined at all. If a line of division or separation is to be drawn at all it must be drawn somewhere, and this somewhere must be dictated in great part by common sense.

As regards the second question (2), Prof. Gill is much more emphatic in his (negative) reply. In the first place, it is pleaded that the marine mammals ought to have been excluded from any analysis bearing upon the subject of zoogeography, "because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones." But surely if these forms are to be excluded, we might for almost identical reasons exclude the birds, since in the distribution of this class of animals factors are involved which are in no way operative in

the dispersal of several other classes of land animals, such as the mammals, reptiles, mollusks, etc. And yet it is largely, indeed it might be said almost wholly, upon the distribution of birds that the principles of zoogeography, with its existing classification, were originally sketched out. Granting, however, for the sake of argument, the justice of plea made, are the results in any way materially affected or altered? Most emphatically not, as will be made manifest by an examination of the accompanying tables, where the original and new (or reduced) data are placed immediately under each other:—

Of 26 Nearctic families (land and marine) 19 are also Palæarctic = 74 per cent.

Of 23 Nearctic families (land only) 16 are also Palæarctic = 70 per cent.

Of 74 Nearctic genera (land and marine) 35 are also Palæarctic = 47 per cent.

Of 62 Nearctic genera (land only) 26 are also Palæarctic = 42 per cent.

Of 74 Nearctic genera (land and marine) 26 are peculiar = 35 per cent.

Of 62 Nearctic genera (land only) 23 are peculiar = 37 per cent.

The 26 peculiar Nearctic genera (land and marine) comprise 60 species, or 21 per cent. of the entire number (279) of species.

The 23 peculiar Nearctic genera (land only) comprise 57 species, or 21 per cent. of the entire number (267) of land species.

It will thus be seen that the greatest variation in any place is only *five* per cent. If, as has been done in my paper, we unite the Nearctic and Palæarctic regions, we will then have, as claimed:—

86 peculiar genera (land and marine) out of a total of 139 = 62 per cent.; or, deducting the marine forms –

74 peculiar genera out of a total of 127 land forms = 58 per cent.

And if we consider the specific forms represented by these peculiar genera, we have —

284 out of a total of 675 (land and marine) = 42 per cent.; or, deducting the marine forms—

264 out of a total of 655 land forms = 40 per cent.

Here again, therefore, the variation is reduced to an insignificant amount—to 4 and 2 per cent.

It has been further objected, that "a more logical classification of mammals" than that which has been followed in my paper, would reveal facts materially contravening my tabular statements, but Prof. Gill fails to inform us what this "more logical classification" may be, and it therefore becomes impossible to theorize on his premises.[1] The distinguished naturalist of Washington is, however, certainly in error when he maintains that the Arctamerican fauna has 4 (instead of 2—*Haploödontidæ* and *Zapodidæ*—or at the utmost, including the not generally recognized *Antilocapridæ*, 3) peculiar families; nor can we understand from his data how, if 29 Eurasiatic genera are represented in Arctamerica, only 23 Arctamerican genera are developed in Eurasia.

From what has already been said it will be seen that there is nothing in either Mr. Wallace's or Prof. Gill's arguments which might tend towards altering my views on the question at issue; and I must therefore still maintain, in the face of the evidence before us, that, in my judgment, there is not even the shadow of a peg upon which to hang the Nearctic (as distinct from the Palæarctic) region of zoogeographers.

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[1] There can be no doubt that certain emendations to the classification followed might have been advantageously made; as, for example, by the introduction of the genus *Cariacus;* but the very few alterations that could have been suggested through the works of the most recent, and, as usually recognized, most competent authorities on the subject of the mammalia, would produce no really appreciable difference in the result.

NOVEMBER 27.

The President, Dr. LEIDY, in the chair.

Forty-two persons present.

Note on Two New California Spiders and their Nests.—Rev. Dr. McCOOK presented a small collection of spiders received from Mr. W. G. Wright, San Bernardino, Cal., mailed November 18. One of these came within a nest, and is a Saltigrade spider, probably an *Attus*. The nest is a rare one, and was so happily placed, by the builder, on a branch of sagebrush (*Ephedra antisyphilitica*), that it was preserved intact. It is the only one which Mr. Wright had seen in site. Another nest, which he had no doubt was the same, he had observed torn from its place by some bird, as material for the construction of a bird's-nest.

Nests somewhat similar are habitually made by Pennsylvania Saltigrades upon or among leaves which shrink up as they die and tear the spinning work so as to destroy the specimen. The one exhibited was in perfect condition. It is the tent and egg-nest of the species which was alive within it, and the speaker thought to be new. It is a large example, five-eighths inch in body-length, stout, the legs of moderate thickness, the whole animal covered closely with grayish white hairs, the skin beneath being black. Dr. McCook named the species, provisionally, *Attus opifex*, with a double reference to the discoverer (Mr. Wright) and the admirable housewright qualities of the aranead herself. The nest is externally an egg-shaped mass of white spinning-work, three inches long by two and one-half inches wide. The outer part consists of a mass of fine silken lines crossing in all directions and lashed to the twigs within which it is enclosed. This maze surrounds a sac or cell of thickly-woven sheeted silk, irregularly oval in shape, two inches long by one inch wide, and also attached to the surrounding twigs. At the bottom this cell or tent is pierced by a circular opening which serves the spider as the door of her domicile. It is the habit of her genus to live and hibernate within such a silken nest. Against one side of the tent within is spun a lenticular cocoon (double convex) of thick white silk, within which the eggs were placed. The young spiders when received had escaped from the cocoon, and occupied the package-box. They are about one-eighth inch long, resembling the mother, but less heavily coated with gray.

This collection also contained three specimens (♀) of the genus *Pucetia*, as defined by Thorell.[1] This genus belongs to

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[1] See "On European Spiders, Novæ Acta Reg. Soci. Sci. Upsalensis," vol. vii, ser. 3d, p. 196.

the family Oxyopoidæ of the Citigrade spiders, to which it is doubtless properly relegated in spite of certain analogies with the Attoidæ (Saltigrades) on the one hand, and the Philodrominæ (Laterigrades) on the other. Mr. Wright calls them "jumping spiders." Hentz, who describes several species of *Oxyopes*, says that *O. salticus* leaps with more force and vivacity than an *Attus*.[1] Of *O. viridans* he thinks it possible that the mother carries its young like *Lycosa*. This family of spiders is arboreal in habit, is found on plants, with their legs extended, thus disguising themselves after the manner known as "mimicry," and springing upon their prey. The cocoon is usually conical, surrounded with points, placed in a tent made between leaves drawn together and lashed, and is sometimes of a pale greenish color. *O. viridans* will make a cocoon suspended mid-air by threads attached to the external prominences, which she will watch constantly from a neighboring site. Dr. McCook believed the species presented to be new; the body-length is fourteen millimetres; legs long, tapering, many long spines. The body is yellow and pale yellow; the cephalothorax striped longitudinally with bright red streaks; the abdomen marked above with red bell-shaped and angular patterns, and beneath by red streaks; the sternum red, the legs yellow with red rings at the joints. The species was named *Pucetia aurora*, because of the bright red streaks upon the yellow background, suggesting "the daughter of the dawn."

According to some field-notes forwarded by Mr. Wright since the above was in print, *Pucetia aurora* is rather abundant in a limited locality. The nests are uniformly upon bushes of *Eriogonum corymbosum*, and several specimens of them were sent. The nest is hung from three to four feet from the ground, and, being upon the topmost twigs, is easily seen from a distance. The cocoon is a straw-colored sphere or ovoid, five-eighths of an inch in diameter. It is covered externally with various pointed rugosities, from which numerous lines extend to the adjoining foliage, and into the maze of right lines which extends below the corymb of the plant upon which all the specimens sent are attached. This retitelarian snare doubtless serves as a temporary home for the young spiders. The cocoon has no suture, the spiderlings escaping by cutting the case, which is thick and closely woven. No floss padding was found inside of the case.

Upon approaching the nest, the mother is usually seen hovering over the young spiders, or guarding a new sack of eggs. She lays two, and sometimes three broods on one twig. Sometimes the young ones will be still in the old nest, while the mother is guarding a new bundle of eggs immediately adjoining the old one. In no case were any young ones seen on the mother's back. The mother stays close by her nest. If the

[1] "Spiders of the United States," p. 48.

spiderlings be hatched, she will, perhaps, drop down a foot or so, if a first effort to capture her be not successful; but will not drop to the ground, unless forced to do so. If guarding her eggs, she must be forcibly separated from the cocoon. The young ones take alarm sooner than their mother; they drop down a few inches—or, at times, two feet—every one on its tiny thread, forming a pretty, swaying fringe. In a few moments, if all is still, they climb up again; but if frightened, will drop to the ground, and run. The little ones in such case do not jump.

It is a further interesting fact in so-called "mimicry" that of several examples of *P. aurora* seen by Mr. Wright, one found on a *green* bush was in color almost wholly green, with scarcely a trace of red; while two found on a hoary-white bush had simulated the white color of their habitat. The specimens, as described above by Dr. McCook, approach in coloration the prevailing hue of the *Eriogonum* on which they were nested, and he was inclined to think that this is the normal color of the adult, which is taken on as the animal matures; indeed, as the green and whitish specimens were not sent to him, he would be inclined to think (awaiting further evidence) that those colors may have been due to immature age. At least, the tendency to such colors is strong in young spiders. However, the fact of mimicry is not improbable, as Dr. McCook had observed it in our native Laterigrades.

From the same gentleman and locality, Dr. McCook had received a ♀ specimen of *Argiope fasciata*, which is thus located upon the Pacific Coast, giving this beautiful and interesting spider a continental distribution.

A Web-Spinning Neuropterous Insect.—Dr. Henry C. McCook announced that a small neuropterous insect, *Psocus sexpunctatus*, had been recently found on the Wissahickon Creek, Fairmount Park, Philadelphia, by Mr. S. F. Aaron, of this Academy. This is the first time, so far as the speaker was aware, that this insect has been found in the United States, or indeed North America. Mr. Aaron took the insects home in the paper boxes in which he had collected them, and thus observed the fact which has heretofore been noted of the European species, that they *spin webs*. McLachlan[1] expresses the belief that both sexes possess the power of spinning a web, which, he affirms, is not distinguishable from that made by spiders. If a number of living specimens be enclosed in a pill-box, it will be found that at the end of a few hours the interior is traversed in all directions by numerous lines of web. Mr. McLachlan further states that the eggs, which are laid in clusters, are also protected with a web by the female. These insects are very common in England, where

[1] Monograph of the Brit. Psocidæ, Entom. Monthly Magz., vol. iii, 1866-67, p. 228.

they are found more or less in societies, on tree-trunks, palings, amongst the herbage of trees, and even in houses. Mr. Aaron discovered them in similar habitat here, that is to say on the trunks of trees. A congener of the above species, *Psocus purus* Walsh, which is also found in the vicinity, makes a tubular or tent-like web in the furrows of bark and crevices of trees, in texture something like that spun by certain tube-weaving (Tubitelariæ) spiders and other species; or, perhaps more nearly like the covering woven over themselves by certain Lepidopterous larvæ. The insect lives under this tent precisely as do the spiders referred to. One who would capture them must push them out by pressing upon the tent.

It is a matter of such rare interest to find a true insect in the imago state spinning a web, and apparently for its protection, that Dr. McCook thought the discovery in our locality of such an insect worthy of this record. The spinning function among true insects, he believed, with the single exception of the Psocidæ, is confined to the larval state; spiders (it is scarcely necessary to state) not being true insects, but belonging to the Arachnida. The speaker further thought that this larval characteristic of web-spinning might be correlated with the rank which zoologists usually assign the Neuroptera as lowest among the orders of the insects, its larva-like body being one indication of its low position in its class. However, it is a striking example of the diverging and independent lines along which life-forms have sprung up in nature, that a function which belongs to the larval stage of insects, and which appears in the imago state only in the lowest type of the same, should appear as the most permanent and characteristic function of the spider—an animal which, although it is now commonly given a lower place in the same subkingdom with the insects (Arthropoda), is certainly very differently and little less highly organized. It would be a difficult task, Dr. McCook thought, to trace or even imagine any evolutionary connection, whether of progression or retrogression, between the web-spinning spider, the web-spinning insect-larva, and the web-spinning neuropterous imago *Psocus sexpunctatus*. There is, indeed, this common factor, the spinning function, but the physiologist fails to perceive any use or combination of the same which can unite the organisms in which it inheres.

Art. VI, Chap. X, of the By-Laws was amended by striking out from the first line the word "only," and from the second and third lines the words "obtain permission to," so that the article now reads: "Members and Correspondents of the Academy shall have free access to the library. Other persons may consult it at any time through the introduction of a member, or upon application to the librarian, while such member or librarian is present.

but minors under sixteen years of age shall not be permitted to examine any work, except under the immediate supervision of the librarian or of a member."

Art. VII, Chap. XI, was amended by striking out all after the word "public," in the second line, and inserting in lieu thereof, "daily, except Sunday, and at least one day in the week without charge on such conditions and under such regulations as the Council shall establish from time to time," so that the article now reads: "The Museum of the Academy shall be open to the public daily, except Sunday, and at least one day in the week without charge, on such conditions and under such regulations as the Council shall from time to time establish."

The following were elected members: George L. Knowles, Ferdinand McCann, Lewis E. Levy, J. Alexander Savage, and Mrs. Wm. E. Ellicott.

The following were elected correspondents: E. Marie, of Paris, Marchese di Monterosato, of Palermo, and H. J. Carter, of Budleigh-Satterton, Devonshire, England.

The following were ordered to be printed:—

NOTES ON AMERICAN FISHES PRESERVED IN THE MUSEUMS AT BERLIN, LONDON, PARIS AND COPENHAGEN.

BY DAVID S. JORDAN.

In a recent visit to Europe, the writer had the privilege of examining numerous typical specimens of American fishes, preserved in the British Museum, in the Museum d'Histoire Naturelle in Paris, and in the Museums of the Universities of Berlin and Copenhagen. In the present paper are given selections from the notes taken on these specimens, which have a bearing on the nomenclature of our fishes.

I have to express my personal obligations to Dr. G. A. Boulenger, of the British Museum; to Dr. Bocourt and M. Thominot, of the Museum at Paris; to Dr. F. Hilgendorf, of the University of Berlin, and to Dr. Christian F. Lütken, of the University of Copenhagen, for many favors in connection with our studies of these specimens.

1. **Arius assimilis** Günther.

(Cat. Fishes Brit. Mus., v, 146.)

Type, Lake Yzabal, Atlantic slope, Central America.

Area between the eyes smooth, extending backward in the form of a rather narrow triangle which is moderately obtuse behind. Fontanelle narrow and short, ending far in front of the occipital process, not extending backward as a groove behind the smooth area of the top of the head; posterior end of fontanelle midway between tip of snout and middle of ante-dorsal shield. Occipital process broad, its edges not straight. Band of palatine teeth large, but not produced backward on the inner margin.

The character of the fontanelle in this species is not described by Dr. Günther. We have elsewhere identified with *A. assimilis* (Bull. U. S. Fish. Comm., 1882, 47), a number of specimens from Mazatlan (28161, 28189, 28210, 28213, 28221, 28232, 28276 and 28304, U. S. Nat. Mus.), belonging to a species very different from the true *A. assimilis*, although agreeing fairly with Dr. Günther's description.

There is no evidence of the occurrence of the true *A. assimilis* in Pacific waters.

2. **Arius cærulescens** Günther.

(Cat. Fish. Brit. Mus., v, 149.)

Types from Huamuchal, Pacific slope.

Head more depressed than in *A. assimilis.* Fontanelle very short, ending abruptly behind and not produced in a groove behind the smooth area of the top of the head, the boundary of the smooth area being rather broadly convex. Occipital process broader than long, its edges nearly straight. Bands of palatine teeth small, not produced backward on the inner margin. Paired fins black at base above. This species is allied to *A. guatemalensis*, but is apparently distinct. It is well separated from *A. assimilis.*

3. **Arius seemanni** Günther.

(Cat. Fish. Brit. Mus., v, 147.)

(? *Arius assimilis*, Jor. & Gilb., Bull. U. S. Fish Com., 1882, 47.)

Type from Central America, the exact locality unknown.

Fontanelle extending backward in a deep and narrow groove, which reaches the occipital process. Middle of top of head smooth, much as in *A. platypogon.*

It is probable that this specimen belongs to the species heretofore erroneously called by us *Arius assimilis.* We have had some hesitation in making this identification, because in none of our Mazatlan specimens does the fontanelle reach the occipital process, and it is not certain that the type of *A. seemanni* came from the Pacific coast. Still, the probability is so strongly in favor of identity that, in absence of further evidence, we shall consider them the same.

4. **Myrophis punctatus** Lütken.

(Vidensk. Meddel. Nat. Foren., Kjöb, 1851, 1.)

Type, West Indies; Suenson Coll.

Beginning of dorsal midway between gill-opening and vent. Head $2\frac{2}{3}$ in trunk. Cleft of mouth about $3\frac{1}{2}$ in head. This is apparently identical with *M. microstigmius* Poey (Rep. Fis. Nat., ii, 50). The description of *M. punctatus* Gthr. (viii, 51) is taken from the Panama species, *M. vafer* Jor. & Gilb. It is barely possible that *M. lumbricus* Jor. & Gilb. will prove to be the young of *M. punctatus.*

5. **Exocœtus rufipinnis** Cuvier & Valenciennes.

(Hist. Nat., Poiss., xix, 99.)

Type from Payta, Peru; an adult specimen, in good condition. Head $4\frac{4}{5}$ in length to base of caudal; depth $5\frac{2}{3}$; lower lobe of caudal $3\frac{1}{3}$; eye $3\frac{1}{3}$ in head. Ventrals $3\frac{1}{3}$ in body. D. 11; A. I, 11. Insertion of anal scarcely behind that of dorsal, its base but little shorter; both fins low, the longest ray of dorsal little more than half the base of the fin. Pectorals reaching base of caudal; ventrals to just behind last ray of anal. Third ray of pectoral branched, the fourth longest. Pectorals and ventrals centrally dusky, without distinct markings.

This species is probably identical with *E. dowi* Gill (Proc. Ac. Nat. Sci. Phila., 1863, 167), from Panama, a species not now represented in the National Museum.

6. **Tylosurus hians** (Cuv. & Val.) Jor. & Gilb.

(*Belone hians* Cuv. & Val., xviii, 432.)

In the type of this species the insertion of the ventrals is about midway between the base of the caudal and the middle of the arch of the base of the upper jaw, or slightly nearer tip of pectoral than front of anal. According to Valenciennes, "elle est attaché un peu avant le milieu de la longueur totale." This statement is not quite correct. On account of this discrepancy, Poey has described the Cuban fish as distinct, under the name of *Belone maculata* (Mém. Cuba, ii, 290), the ventral fin being inserted *behind* the middle of the length of the body. It is not likely that any real difference exists. The specimens found along our Atlantic coast agree very well with Poey's description.

7. **Querimana harengus** (Günther) Jor. & Gilb.

(*Myxus harengus* Günther, iii, 467.)

The types of *Myxus harengus* have but two anal spines, instead of three, as stated in the original description. Specimens of this species from Zorritas, Peru, are in the museum of Yale College. In the National Museum are specimens from Panama, Mazatlan, and Charleston, S. C.

8. **Querimana ciliilabis** (Cuv. & Val.) Jor.

(*Mugil ciliilabis*, C. & V. xi, 151.)

The types of *Mugil ciliilabis*, from Lima, belong also to the genus *Querimana*. The species is very close to *Q. harengus*, differing in rather stronger dentition, stiffened cilia, or teeth being present in both jaws, rather strongest in the upper. Head $3\frac{2}{6}$ in

length, depth $4\frac{1}{4}$; no adipose eyelid; preorbital serrate; anal spines 2; first soft ray of anal simple, but evidently articulate.

9. **Stromateus medius** Peters.

(Berliner Monatsber., 1869, 707.)

Type, No. 7073, Berlin Museum, from Mazatlan. In the original description of this species the lateral line is said to be "keeled" on the caudal peduncle. This "keel" is simply the ordinary tubing of the lateral line, which is precisely as in the ordinary species of *Stromateus.*

Head $3\frac{1}{2}$ in length, depth $1\frac{9}{10}$; pectoral $2\frac{3}{8}$ in body; dorsal lobe $4\frac{1}{4}$; caudal $2\frac{3}{4}$. Dorsal with 42 developed rays; anal with 32. Length $7\frac{1}{2}$ inches, fins distinctly punctulate.

10. **Caranx leucurus** Günther.

(Proc. Zool. Soc. Lond., 1864, 24.)

Types, two young examples. In our Review of the Carangidæ (Proc. U. S. Nat. Mus., 1883, 194)[1] we have placed this species in the group called *Uraspis*, among the species with broad maxillaries. It should be removed to the group called *Hemicaranx*, among the species with narrow maxillaries, its relations being with *C. atrimanus* and *C. amblyrhynchus.*

Maxillary quite narrow, its length $2\frac{2}{3}$ in head, reaching pupil; eye not large. Dorsal and anal fins unusually high, but the anterior rays not exserted beyond the rest; middle rays of dorsal $\frac{1}{2}$ to $\frac{2}{3}$ length of head (probably shorter in the adult); sheath at base of dorsal little developed; caudal fin not deeply forked; pectoral short, $1\frac{1}{3}$ in head (young); curve of lateral line $1\frac{1}{2}$ in straight part, its length $3\frac{1}{3}$ times its depth. Teeth slender, rather long, uniserial above and nearly so below.

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[1] In the paper above quoted (p. 194) we have placed *Caranx ruber* in the group with the anterior rays of soft dorsal and anal not falcate. In specimens from Guiana examined by us, these rays, although very low, are still, properly speaking, falcate, the longest being about $2\frac{1}{3}$ in head. The species should therefore be removed from the subgenus *Uraspis* to that of *Caranx.*

On page 197 in the same paper, *Caranx fasciatus*, Cuv. & Val. (ix, p. 70), described from a drawing made in Mexico, may be added as an extremely doubtful synonym of *Caranx cinctus.*

Caranx cubensis (Poey) should doubtless be recognized as a distinct species.

On pages 206 and 207 the name *Chloroscombrus stirurus* occurs. This is a *lapsus* for *Chlor. orqueta*, the former having been a MSS. name for which the latter was substituted before the publication of the original description.

Body everywhere finely punctulate, with rather sharply defined dark bars. Caudal fin pale.

11. **Epinephelus galeus** (Müller & Troschel) Jordan.

(*Serranus galeus* Müll & Trosch., Schomb. Reise, Brit. Guiana, 621.)

The types of *Serranus galeus* belong apparently to the species described as *Serranus itaiara* Cuv. & Val. and Vaillant & Bocourt, and as *Serranus quinquefasciatus* Bocourt. According to Vaillant & Bocourt (Miss. Sci. au Mexique), the species found on the Pacific Coast of Mexico (*quinquefasciatus*) is identical with the Brazilian species (*itaiara* C. & V.). The original *Serranus itaiara* of Lichtenstein is, however, apparently a very different species, having the anal rays III, 11. Assuming the identity of the Atlantic and Pacific species, which I have, at present, no reason to doubt, the oldest tenable specific name for this species seems to be *galeus*.

12. **Lutjanus argentiventris** (Peters) Jordan & Gilbert.

(*Mesoprion argentiventris* Peters, Berliner Monatsber., 1869, 707.)

Type, No. 7070, Berl. Mus., from Mazatlan. This specimen belongs to the species diagnosed by us under the name of "*Lutjanus argentivittatus*" (Proc. U. S. Nat. Mus., 1881), the Pacific representative of *Lutjanus caxis*. The name "*argentivittatus*" is a slip of the pen on our part for "*argentiventris*."

13. **Lutjanus inermis** (Peters) Jordan & Gilbert.

(*Mesoprion inermis* Peters, Berliner Monatsber., 1869.)

Type, 7069, Berlin Mus., said to have been brought from Mazatlan; 8½ inches in length, in good condition.

This specimen belongs to a species allied to *L. chrysurus*, and distinct from all those yet known from the Pacific Coast of Tropical America. The following is a detailed description:—

Head 3 in length; depth 3¼. Lateral line with 50 tubes; scales 53. Dorsal X–13; A. III–11.

Body slender and fusiform, not strongly compressed, the back not elevated. Snout very pointed; mouth unusually small, the maxillary 2½ in head, reaching to front of pupil. Eye very large, about 4 in head. Band of vomerine teeth slightly produced backward on the median line. Teeth on tongue well developed; canine teeth unusually small and slender, 2 in upper jaw and 3 or 4 on each side of lower. Nostrils well separated,

subequal, the posterior oblong, the anterior round. Preorbital $\frac{3}{5}$ depth of eye. Preopercle not serrate, scarcely notched behind. Temporal region with a band of large scales, on each side of which are small scales. Scales above lateral line arranged in very oblique series which are not parallel with the lateral line.

Pectoral fins very short, reaching little past tips of ventrals, $1\frac{3}{4}$ in head. Dorsal spines very slender. Second anal spine longer than third, very small, 7 in head. Soft dorsal and anal low, scaly. Caudal fin rather deeply forked, the middle rays not half the length of the outer, which are $1\frac{1}{3}$ in head.

Color in spirits, dusky above, pale below, with distinct dark stripes, those below parallel with the lateral line, those above very oblique; these stripes extend along the edges of the rows of scales, the middle of each scale being whitish, its base dusky.

According to Peters, the color was "violet-brown; middle of each scale with a silvery shining spot; belly silvery."

14. **Lutjanus vivanus** (Cuvier & Valenciennes) Jordan & Gilbert.

(*Mesoprion vivanus* Cuv. & Val., ii, 454.)

Types, young specimens in good condition, collected by Plée at Martinique.

This species is briefly and unrecognizably described by Cuvier & Valenciennes. The following is an outline of its characters, from which its close resemblance to the young of the common "Red Snapper" of Florida (*Lutjanus blackfordi* Goode & Bean = *L. campechianus* Poey) is evident.

Head $2\frac{5}{6}$ in length; depth $3\frac{1}{6}$. D. X–14; A. III–8. Lateral line with 50 pores.

Maxillary $2\frac{4}{5}$ in head; teeth rather strong; vomerine teeth in an arrow-shaped patch, being prolonged considerably backward on the median line. Posterior nostrils oval; eye 4 in head; Nuchal scales in a band, scarcely separated from the scales of the body; scales above lateral line arranged in oblique series; second anal spine long, $2\frac{1}{2}$ in head; caudal concave, the inner lobe $1\frac{2}{3}$ in the outer.

Color reddish, faintly streaked with olive; traces of a blackish blotch under soft dorsal; tips of middle rays of caudal dusky.

15. **Pomadasys modestus** (Tschudi) Jordan.

(*Hæmulon modestum* Tschudi, Fauna Peruana, Ichthyol., ii.)

(*Pristipoma notatum* Peters, Berliner Monatsber., 1869.)

The type of *Pristipoma notatum* Peters (No. 7061, Berl. Mus.: "gekauft, angeblich von Mazatlan") is identical with specimens

in the same museum, which have been identified, apparently correctly, as *Hæmulon modestum* Tschudi. This identity has been already noticed by Dr. Hilgendorf (MSS.). Tschudi's original type is said to be in the museum at Neufchatel.

It is doubtful whether the specimen examined by Prof. Peters really came from Mazatlan.

The following is a redescription of the type of *Pristipoma notatum*:

Head $3\frac{1}{3}$ in length to base of caudal; depth $2\frac{2}{5}$. D. XII–15 (not XVIII, as stated by Peters); A. III–12; 51 or 52 scales in a longitudinal series; 10 rows between front of dorsal and lateral line.

An ally of *Pomadasys cæsius*. Body ovate; anterior profile regularly convex; mouth small; outer teeth in both jaws enlarged; maxillary $3\frac{3}{4}$ in head; lips thick; eye $3\frac{3}{4}$ in head; preorbital $1\frac{2}{3}$ in eye; preopercle coarsely serrate; scales above lateral line unusually small, arranged in oblique series, not parallel with the lateral line.

Pectoral fin as long as head; second anal spine much stronger than third, and somewhat longer, both much shorter than the soft rays; second anal spine $1\frac{2}{3}$ in head; dorsal spines low and not strong, the fin deeply notched; fourth dorsal spine $2\frac{1}{3}$ in head; soft dorsal scaly at base; upper lobe of caudal longest.

Color bluish gray, silvery below; edge of opercle black; a conspicuous jet-black spot at base of last rays of anal and dorsal; entire axil of pectoral, and a large roundish blotch before it, jet-black; ventrals blackish.

16. Diabasis sexfasciatus (Gill) Jor. & Gilb.

As already supposed by us, the type of *Hæmulon maculosum* Peters is identical with *Hæmulon sexfasciatum* Gill.

17. Paralonchurus petersi Bocourt.

Type, La Union, San Salvador.

Only the original type of this species is yet known. It is apparently closely related to the genus *Lonchurus*, differing externally in the presence of several barbels instead of two.

Body long and low, formed as in *Menticirrus*. Head slender, low, with protuberant snout, flattish and somewhat spongy to the touch above. Preopercle with dermal serrations; mouth horizontal, overlapped by the snout; teeth in villiform bands; upper jaw with a conspicuous outer row of larger teeth; gill-rakers

very small, short and slender, not numerous; chin with five pores; rami of mandible each with a row of slender, inconspicuous barbels along the inner edge; nostrils round.

Scales rather large, smooth to the touch, apparently truly cycloid.

Head $3\frac{1}{4}$ in length; depth 4; eye very small, $8\frac{1}{2}$ in head; interorbital space $3\frac{1}{4}$; maxillary $2\frac{2}{3}$; dorsal rays XI–30; dorsal fin low, the soft dorsal highest posteriorly and scaled at base only; anal small, ending under middle of soft dorsal, its second spine as long as snout, $3\frac{2}{3}$ in head; pectoral very long, $2\frac{1}{5}$ in body; caudal lanceolate, unequal, its length $3\frac{1}{4}$ in body.

Color in spirits, light olive, with faint streaks along the rows of scales; no cross-bands; pectorals dusky; other fins plain.

18. **Polycirrhus dumerili** Bocourt.

Type, La Union.

This species seems to be identical with *Genyanemus fasciatus* Steindachner (Ichth. Beitr., ii, 31, 1875). The name given by Bocourt has precedence. The genus *Polycirrhus* is perhaps worthy of distinction from *Genyanemus*, having the dorsal spines in normal number (10 instead of 14), the mouth subinferior instead of terminal, the caudal double truncate instead of emarginate, and the gill-rakers very small. *Genyanemus peruanus* Steind. (l. c., 29) and *G. brasilianus* Steind. (l. c., 34 = *Micropogon ornatus* Gthr.) apparently belong to *Polycirrhus*.

19. **Menticirrus saxatilis** (Bloch & Schneider) Jordan.

(*Johnius saxatilis* Bloch & Schneider, Syst. Ichth., 1801, p. 75.)
(*Sciæna nebulosa* Mitch., Trans. Lit. and Phil. Soc., 1815, 408.)

The type of *Johnius saxatilis* Bloch & Schneider, from New York, is still preserved in the museum at Berlin. It is apparently identical with the common king-fish, *Menticirrus nebulosus* (Mitchill) Gill, which species should therefore stand as *Menticirrus saxatilis*. The common names of this species, of the weak fish and the striped bass, have evidently been confused by Schneider.

Johnius carutta, the species taken by Professor Gill as the type of the genus *Johnius*, has the preopercle entire, and the mouth inferior. *Johnius* is apparently not distinguishable from the subgenus *Corvina*, as defined by Jordan & Gilbert (Synopsis Fish. N. A., 1883, p. 932).

20. **Menticirrus nasus** (Günther) Jor. & Gill.

(*Umbrina nasus* Günther, Fishes Centr. Amer., 1869, 426.)

Type, about a foot in length, adult.

D. X–I, 22; eye proportionately very large, $4\frac{1}{2}$ in head; maxillary reaching to below posterior edge of pupil; snout $3\frac{3}{8}$ in head; longest dorsal spine $1\frac{3}{8}$ in head, reaching to third ray of second dorsal; pectoral $1\frac{1}{8}$ in head; ventrals short.

Gill-rakers very short, almost obsolete; posterior nostril large, oval; anterior round; interorbital width $4\frac{1}{8}$ in head; scales of breast large.

Color pale, the pectoral dusky.

21. **Isopisthus brevipinnis** (Cuv. & Val.) Gill.

(*Ancylodon brevipinnis* C. & V., v, 84.)

The type of this species (Cayenne, Poiteau; in bad condition) has the pectoral fin $1\frac{2}{8}$ in head, as in *I. affinis* Steindachner (Neue und seltene Fische aus den K. K. Zöol. Museum zu Wien, etc., 43), differing in that respect from the Panama species, *Isopisthus remifer*. There is not much doubt of the identity of *I. affinis* with *I. brevipinnis*.

22. **Gerres peruvianus** Cuvier & Valenciennes.

(Cuvier & Valenciennes, vi, 467.)

The type of this species is apparently identical with the common West Coast species called by this name by Jordan & Gilbert (Bull. U. S. Fish Com., 1881, 330), and later by Evermann & Meek (Proc. Ac. Nat. Sci. Phila., 1883, 123). The types of *Gerres gula* C. & V. also correspond with the species so named by the above writers. One of them (Brazil, Delalande) has the head 3 in length, the depth $2\frac{2}{3}$; longest dorsal spine $1\frac{3}{4}$ in head; second anal spine $3\frac{1}{4}$; eye $2\frac{3}{4}$; tip of spinous dorsal dusky. The types of *Gerres aprion* C. & V. seem to correspond with the species called by us *Gerres cinereus* (Walbaum) (= *Gerres zebra* and *Gerres squamipinnis* Gthr.). They are, however, in bad condition, the color faded and the scales mostly rubbed off.

23. **Gerres brasilianus** Cuvier & Valenciennes.

(Cuvier & Valenciennes, vi, 458.)

The type of this species is in very bad condition, unfit for detailed description. Sides apparently with dark stripes along the rows of scales. Preorbital and preopercle serrate. Frontal groove broad, naked. Longest dorsal spine 5 in body. Second

anal spine 5¼. Anal spines 3 in number. Caudal fin long. This species is allied to *G. plumieri*, but the back is less elevated and the spines smaller than in the latter. *Gerres rhombeus* C. & V. is a very different species, closely allied to *Gerres peruvianus*, but with two anal spines only. It occurs on both sides of the Isthmus of Panama.

24. **Gerres brevimanus** Günther.

(Günther, Proc. Zool. Soc. Lond., 1864, 152.)

This species is distinct from *G. lineatus* (Humboldt), although closely allied to it. Only the original type is yet known. On this I have the following notes:—

Head 3¼ in length; depth 2⅓; eye 3⅓ in head. Coloration of *Gerres lineatus*. Back much lower than in the latter, and pectoral fins very much shorter; their length 1¼ in head; their tips not reaching nearly to tips of ventrals, which are 1¼ in head; caudal 3 in body. Preorbital very little serrate, almost entire. Preopercle weakly serrate. Second dorsal spine 1⅞ in head; second anal spine 1⅝. Teeth small and short. No black on base of pectoral, or on lower fins. Spinous dorsal dusky above. Frontal groove broad and naked, as in *G. lineatus*.

25. **Opisthognathus punctata** Peters.

(Peters, Berl. Monatsber., 1869.)

Type, 7064, Berl. Mus.; about one foot long, from Mazatlan.

Head everywhere finely speckled with black, the body more coarsely and irregularly spotted. Pectoral finely and closely speckled, its edge plain. Ventral fin dusky, similarly marked. Dorsal without large black blotch, finely spotted, the spots behind gradually forming the boundaries of white ocelli, the base of the fins having rings of white around black spots, the upper part with dark rings around pale spots. Caudal with pale spots, its edge, like that of the dorsal, somewhat dusky, not black. Anal with a broad, blackish edge, and with dark spots, those near the base of the fin largest. Lining membrane of maxillary with the usual bands of white and inky black.

Scales very small, about 125 in lateral line. Dorsal spines continuous with the soft rays. D. 28; A. 18. No vomerine teeth. Maxillary very long, extending slightly beyond head.

Only the type of this species is yet known.

26. **Porichthys porosissimus** (Cuv. & Val.) Gthr.

(? *Batrachus porosissimus* Cuv. & Val., xii, 501.)
(*Porichthys plectrodon* Jor. & Gilb., Proc. U. S. Nat. Mus., 1882, 291.)

The two specimens from South America referred, by Dr. Günther (Cat. Fishes, iii, 176) to *Porichthys porosissimus*, have the enlarged palatine teeth characteristic of *P. plectrodon* Jor. & Gilb. The specimen from Vancouver Island mentioned by Dr. Günther, has small palatine teeth as have all Pacific specimens examined by us. A young specimen from Panama also belongs to *P. margaritatus*. It is probable that the types of *Batrachus porosissimus* C. & V., from Guiana and Brazil, really have the palatine teeth enlarged, although Cuvier & Valenciennes say that "chaque palatin en a une rangie de petites, pointues et inegales." In that case, the Atlantic species would stand as *Porichthys porosissimus* (C. & V.) Gthr., and the Pacific species, unquestionably distinct, although closely related, as *P. margaritatus* (Rich.) Jor. & Gilb.

27. **Sebastodes matzubaræ** (Hilgendorf) Jordan.

The types of *Perca variabilis* Pallas (Zoogr. Rosso-Asiat., iii, 241 = *Epinephelus ciliatus* Tilesius), two in number, obtained in the Aleutian Islands, are preserved in the Berlin Museum.

The smaller of these specimens (6494) belongs to the species for which we have retained the name of *Sebastodes ciliatus* (Jordan & Gilbert, Synopsis Fish. N. A., 658). For this species the name *Sebastes variabilis* has been retained in MSS. by Dr. Hilgendorf.

The larger specimen (8145) is a flat skin of large red species, apparently identical with the Japanese species described by Hilgendorf under the name of *Sebastes matzubaræ*. This view is also held by Hilgendorf.

As *Sebastodes matzubaræ* has not been hitherto recognized as a North American species, we give the following outline of its characters:—

Allied to *Sebastodes miniatus*. Spines of head low, developed about as in *S. miniatus* and *S. pinniger*. Preocular, supraocular, postocular, tympanic, occipital and nuchal spines distinct; a pair of small coronal spines present, as also a small spine before and one just below eye. Maxillary reaching to posterior border of eye, 1⅞ in head. Both jaws covered with rough, ctenoid scales.

Interorbital space flattish, scaled, its breadth a little less than that of eye. Preopercular spines short, simple. Preorbital spines simple. Lower jaw scarcely projecting. Second anal spine scarcely longer than third. Longest dorsal spine $2\frac{3}{4}$ in head, a little less than the longest short rays. Pectoral $4\frac{1}{2}$ in body.

Color dusky brown, apparently dark red in life; three dark shades across cheeks.

28. **Scorpæna histrio** Jenyns.

(Chinchas Islands; Schmaltz; Brit. Mus.)

This species is very closely allied to *Scorpæna brasiliensis* C. & V. It lacks the black spots which are usually distinct in the latter. In *S. brasiliensis* the suborbital stay is more broken, and the dorsal spines are perhaps a little lower.

The following is a diagnosis of *Sc. histrio*:—

Head $2\frac{1}{10}$, depth $3\frac{1}{2}$. D. XII–10. Pectoral $3\frac{1}{10}$ in body. Maxillary 2 in head. Eye $4\frac{1}{3}$ in head. Longest dorsal spine 3 in head. Second anal spine 3. Lateral line with 30 scales.

Head rough above. Nuchal pit quadrate, much broader than long. Scales present on posterior part of cheek and on front and flap of opercle. Scales on body large, not ctenoid, edged with dermal flaps. Eye large. Mouth large, the lower jaw included. Suborbital stay conspicuous, not armed with spines. Second anal spine stronger and rather longer than third.

Color gray or red, with broad darker shades, four in number. irregular and variable; fins similarly colored; pectorals barred; dermal flaps white.

29. **Prionotus horrens** Richardson.

(Voyage Sulphur, Ichthyol., 79.)

Types, Gulf of Fonseca; young. Allied to *Prionotus tribulus* C. & V., but the spines on the head still longer and more knife-shaped. First spine on edge of snout broad and serrate; behind this three similar ones progressively larger. Then two large spines on preopercle, the posterior larger. Two smaller spines on opercle, and one very large on the scapula. Two sharp spines over each eye, one behind; two on top of head and two on occiput. No groove behind eye. Belt of palatine teeth narrow. Mouth large; maxillary reaching to below front of eye, $2\frac{1}{3}$ in head. Gill-rakers long and slender, 5 in number. Scales

small. Pectorals short, 3 in body, reaching somewhat past front of second dorsal.

Pectorals and tip of caudal dusky.

30. **Agonus decagonus** Bloch.

This species has the gill membranes attached to the isthmus, forming a narrow fold across it, much as in *A. cataphractus*, but narrower. It is therefore erroneously referred by us to the genus *Brachyopsis* (Syn. Fish. N. A., 955), and the generic name *Leptagonus* Gill, based on *A. decagonus*, cannot be used instead of *Brachyopsis*. *A. decagonus* is intermediate between *Agonus* proper and *Podothecus*, being referable to the latter, if the two genera are kept separate. According to Dr. Lütken, neither *Agonus cataphractus* nor *Cottus bubalis* have yet been actually found in Greenland. They should, therefore, be omitted from American faunal lists.

31. **Ophidium omostigma** Jordan & Gilbert.

(*Genypterus omostigma* Jor. & Gilb., Proc. U. S. Nat. Mus, 1882, 301.)

An Ophidioid fish has been referred by us to the genus *Genypterus*, which genus we have regarded as distinguished from *Ophidium* chiefly by the presence of a sharp spine on the opercle. In the type of the genus *Genypterus* (*G. chilensis* Guichénot), this spine is obsolete. *G. omistigma* is therefore not a *Genypterus*, and it may probably be referred to *Ophidium*, from which *Genypterus* is separated by Dr. Günther on the variable and unimportant character of the enlarged palatine teeth.

THE OCCIDENT ANT IN DAKOTA.

By Rev. H. C. McCook, D. D.

I have recently received from Prof. J. E. Todd (Professor of Natural Sciences at Tabor College, Iowa, and an Assistant on the U. S. Geological Survey), some valuable facts concerning the distribution of *Pogonomyrmex occidentalis*. While on a visit to Dakota (1882), Prof. Todd had observed a number of ant-hills which awakened his interest, and upon which he made various observations. The facts noted, together with specimens of the insects and scrapings from the mounds, were sent to me, and justify the following record:—

1. *Distribution and Site.*—The ants were seen (A. D. 1882 and 1883) on the Missouri River, south of Bismarck, opposite the mouth of the Cannon Ball River, and at a point seventy-five miles southward. Upon the extensive plain forming the bottom of the Bois Cache Creek valley, and near the sand hills and grove which give the name to the valley, the mounds are numerous. Prof. Todd thinks with some confidence that they are not located in the valley of the James River, nor in Dakota, any considerable distance east from the Missouri River. He has traveled with a team over 2500 miles in Dakota, east of the Missouri River and south of the Northern Pacific Railroad, and has not noticed the ant-hills elsewhere than the localities mentioned. In my book on "The Honey and Occident Ants,"[1] I have located this ant in southern Dakota, upon conjecture, but the above, with specimens, now give scientific confirmation.

I wish to call attention to the additional facts thus contributed in the precise line of the striking feature formerly pointed out by me in the geographical distribution of *Occidentalis*. According to Prof. Todd, the ant is confined to the bottom lands along the Missouri, and *has not pushed eastward* through the Territory. This corresponds remarkably with my conclusion, both from my own observations and those made under my direction by Dr. Horace Griffith, of Marengo, Iowa. This conclusion is that *Occidentalis* does not dwell east of the Missouri

[1] The Honey Ants and the Occident Ants, p. 124 5. J. B. Lippincott & Co., Phila.

River, in Missouri, Iowa and Minnesota; that it avoids eastern, while abounding in western Nebraska, and is not found in Kansas further east than Brookville, longitude 22° W. from Washington, about 97° W. Greenwich, which is nearly that of the sites reported by Prof. Todd. As Prof. Packard has reported the insect in southern Montana, we may now conclude that the entire western part of the great valley of the Missouri (west of the river and the above meridian) is inhabited by this ant and its closely allied congener, *P. barbatus*, the Agricultural Ant.

It is worthy of note that all the authentic reports which we have of the latter insect also limit its eastern distribution to about the same meridian. We have no account of it as inhabiting southern Missouri, Arkansas and Louisiana, except a note of Nuttall's in 1819, which appears to refer to one of these species. Entomologists and naturalists generally in these States might do good service by some attention to this point. It is a question of profound interest, what natural cause has operated to establish this eastern limit of distribution? The writer confesses his inability to discover any relation between the structure and economy of the ant, and the physical condition of the country, that could throw any light upon the question.

The two species very closely resemble each other, the worker forms scarcely differing except in body-size; the worker-major of *Occidentalis* corresponds almost exactly with the minor of *barbatus*. The chief differences in the sexual forms are of size and color, but also a slight difference in venation. There are, however, some marked differences in nidification and habit. The Agricultural Ant occupies the southern section of the above marked geographical district, and it seems scarcely possible to resist the inference that it is a modified form of *Occidentalis* (or *vice versa*) who inhabits the northern section. The local site of the nests in Dakota is generally a sandy flat or bottom.

2. *Nidification.*—From the observations of Prof. Todd, it further appears that the Dakota ants agree with those of Colorado in the position of the gate, at one-half to one-third the distance from the base; in the general appearance of the mounds, which are uniformly in the centre of a circular cleared area three or four feet in diameter. In size they are smaller, being about six inches high and about two feet in diameter. They are roofed in some sites with small gravel stones of quartz, but in others, as at the

mouth of the Cannon Ball River, have no such covering. Prof. Todd is inclined to think that the gravel roofing is selected from the nest vicinage and placed upon the mound; but I believe the stones to have been excavated from the underground galleries, granaries and rooms, and brought up therefrom. However, I think the construction of a roof by selection to be quite within the ability of the Occidents, as I have observed them carrying pebbles up, down and around the mound in all directions after issuing from the gate.

3. *Harvesting habit.*—Among the pebbles sent to me are a number of husks, etc., of various seeds which appear to have been taken from the kitchen-middens or refuse-heaps of the formicary. These indicate that the Dakota emmets, like the more southern examples, are harvesting ants. Mr. Thomas Meehan, to whom was referred a small quantity of the debris collected from the margin of a nest by Prof. Todd, reports that there are no seeds among the pebbles, but that there are a number of calices and undeveloped capsules of a leguminous plant, *Dalea alopecuroides*, which is common on the American plains. I was puzzled to explain why such intelligent creatures should be detected in harvesting immature seeds, until, upon inquiry, I found that leguminous plants have a succession of flowers, so that there may be mature seeds and flowers on a plant at the same time. Mr. Meehan actually found upon a specimen of the above plant in the Academy's Herbarium, both the flower and the fully developed seed; indeed, the two appear to occur upon the same spike. It is thus evident that the ants were not harvesting out of season, but were occasionally deceived, and cast out to the refuse-heaps the calices that contained no edible seed.

STAINING WITH HÆMATOXYLON.

BY CHARLES L. MITCHELL, PH. D., M. D.

Hæmatoxylon or logwood was first recommended by Boehmer for the staining of tissues and sections, for microscopic examinations. Its rapid action, clearness of differentiation and beautiful tint soon made it a favorite staining agent with microscopists. Possessing even a greater selective power than carmine in separating and staining the bioplasm of animal and vegetable tissues, it was also superior to this coloring agent in the fact that the violet tint of the logwood was not nearly so fatiguing to the eye in prolonged examinations with the microscope. The deeper hue of the logwood-coloring was also an advantage in the fact that the contrasts of colored and uncolored tissue afforded by its use produced a much more perfect definition and clearness of outline than could be produced by a brighter color. Nucleus, nucleolus and cell-wall, when stained by this agent, all stand out clearly and with perfect distinctness and sharpness of outline—a result not to be attained by the use of any other coloring material.

The use of logwood as a staining agent, however, was soon found to be attended with strong and serious disadvantages. The staining fluid soon became thick, cloudy and filled with a grumous sediment, at the same time changing its color; sections and tissues, stained with it, were of a dirty brown color and soon faded, and, unless the solution was freshly prepared, the results obtained from it could not be depended upon. The numerous formulæ, published by Kleinenberg, Boehmer, Miller, Klein and many others, some of which formulæ are exceedingly complicated, are sufficient proof that the task they undertook was not an easy one; and, judging by the results, a simple, satisfactory formula for preparing this desirable coloring agent has yet to be published. It is my purpose this evening, to call the attention of the members of the Section to a new and simple method of preparing a logwood staining fluid, by which a permanent, reliable and satisfactory preparation can be easily made. This method, I think, will place within the reach of every microscopist a staining fluid which is stable in composition, comparatively easy of preparation and unequaled in the delicacy and clearness of differentiation of its

coloring. I have previously, at several different meetings of the Section, alluded to my experiments with this agent, and have also shown at different times some specimens of tissues stained with it; but I did not feel willing to place my results definitely before you, until sufficient time had elapsed to fully test the permanence of the preparation and of the stainings produced by its use. I have placed before you this evening, however, under the different microscopes on the table, a series of preparations, single and double stainings, which will, I think, speak for themselves, and also a sample of the staining fluid. Both fluid and specimens were prepared nearly a year ago.

In considering the method of preparation of this fluid, it will be well to review briefly the chemistry of logwood. Logwood is the heart-wood of *Hæmatoxylon Campeachianum*, a large tree found in Campeachy, Honduras and other parts of tropical America, and is used extensively in the textile arts for dyeing fabrics of a purple, blue or black color. Among its chemical constituents are resinous matter, a peculiar tannin, free acetic acid, various salts and nitrogenous principles, and a peculiar principle called hématin, or hæmatoxylon, on which the coloring properties of the wood depend. This hématin is, when pure, perfectly colorless, but affords beautiful red, blue and purple colors when in union with an alkaline base and the oxygen of the air. It also combines with the alums to form *lakes*, that peculiar class of coloring substances of which carmine is so remarkable an example. Now, this lake of logwood is the principle which acts as the dye; and, in order to obtain the color in all its delicacy and purity, all other contaminating impurities must be removed. The various formulæ for the preparation of a logwood staining fluid have nearly all directed the use of the commercial extract of logwood, which, aside from the numerous impurities necessarily found in so crude an article, is totally unfit for the purpose, for reasons which I will presently point out.

As already mentioned, logwood contains, besides its coloring principle, considerable quantities of tannin—so much, in fact, as to give it a position in the U. S. Pharmacopœia as an astringent. It is well known that vegetable infusions containing tannin are quickly influenced by the action of both light and air, and when these are assisted by heat, changes take place very rapidly. Under these circumstances, the infusions change color, become

cloudy and deposit large quantities of an insoluble sediment. It therefore can be readily understood that an extract of logwood, prepared by the evaporation of an infusion of the drug, must be to some extert changed by the process of manufacture, and that any preparation made from it would (the process of decomposition having already been started) become much more liable to change. And just such a result takes place in staining fluids prepared from extract of logwood. The partially oxidized tannin in the liquid gradually absorbs more oxygen from the air, and changes to other complex organic compounds; the coloring matter is also affected by the decomposition, and gradually becomes converted into other substances, and the liquid finally becomes of a dirty, muddy color, and is half filled with a lumpy sediment. This change will be found to take place in all ordinary logwood staining fluids, whether prepared from the extract or from the drug itself, although from the nature of the case those made from the extract would be the most quickly affected. The idea, therefore, occurred to my mind, that if the tannin could be removed, and the lake of logwood isolated in a state of comparative purity, a staining fluid could be prepared which might possibly be both permanent and satisfactory. After numerous and lengthy experiments, the desired object was obtained, and the formula which I now present to your notice is the result of my investigation on the subject. As a means of distinguishing this preparation from the other and generally worthless logwood fluids, I have thought it best to call it

"MITCHELL'S HÉMATIN STAINING FLUID."

℞

Finely ground logwood,	℥ ij.
Sulph. aluminum and potash (potash alum),	ʒ ix.
Glycerine,	f. ℥ iv.
Distilled water,	a sufficient quantity.

Moisten the ground logwood with sufficient cold water to slightly dampen it, place it in a funnel or percolator, packing it loosely, and then percolate sufficient water through the drug until the liquid coming from the percolator is but slightly colored. Allow the drug to drain thoroughly, and then remove it from the percolator, and spread out on a paper or board to dry. Disselve the alum in eight fluid-ounces of water, moisten the dry drug with a sufficient quantity of the fluid, and again pack in the percolator, this time rather tightly, and pour on the remainder of the alum solu-

tion. As soon as the liquid percolates through and commences to drop from the end of the percolator, close the aperture with a tightly fitting cork, and allow the drug to macerate for forty-eight hours. Remove the cork at the expiration of that time, allow the liquid to drain off, and then pour sufficient water upon the drug to percolate through twelve fluid-ounces altogether. Mix this with the glycerine, filter and place in a close-stopped bottle.

In this process nearly all the tannin is removed by percolating the drug with cold water, a menstruum in which the coloring principle is not very soluble, and the subsequent maceration and percolation with the alum solution removes the logwood lake in a state of comparative purity. The glycerine is added simply for its preservative qualities, and this may be still increased by the addition of a few drachms of alcohol to the solution.

The hématin staining fluid thus prepared is a clear, heavy fluid of a deep purplish red color. It will keep its color for a length of time, and deposits no sediment. The sample exhibited to the meeting this evening has been on my working table for nearly a year, frequently exposed to a strong light and open to the air, and, as you may see, it is as yet unchanged. As a staining fluid, used either strong or diluted, I consider it far superior to any other stain I know of. Permanent and beautiful in its color, which is of a delicate violet hue, clear and sharp in its definition of the different tissues under examination, it will bear use with the very highest powers of the microscope, and, I hope, enable observers to distinguish minute differences of tissue which have hitherto escaped notice.

A few words in conclusion as regards the method of using this fluid. It yields good results, when used undiluted, as a quick stain; but the most excellent results, to my mind, are obtained by placing the tissues in a weak solution (ten drops to two fluid-drachms), with warm distilled water, for about twelve hours. This method leaves nothing to be desired, and produces results of surpassing delicacy and beauty. I had intended, in conclusion, to refer to the beautiful double-staining produced by this agent in connection with a new preparation of indigo-sulphuric acid, and have several specimens on exhibition this evening; but I think it will be best to devote a separate paper to the consideration of this subject, which I trust to be able to present at a future meeting of this Section.

December 4.

The President, Dr. Leidy, in the chair.

Thirty-six persons present.

A paper entitled "A Study of the Distribution of Gluten within the Starch Grain," by N. A. Randolph, M. D., was presented.

Gold from North Carolina.—Prof. H. Carvill Lewis exhibited some remarkable gold nuggets, found in Montgomery county, North Carolina, forty miles east of Charlotte and two miles from Yadkin River. Some of the nuggets were of great size. One of them weighed over four pounds, and contained nearly $1000 worth of gold, being finer than any specimens in the collection at the Mint. It was probably one of the largest nuggets ever found in eastern America. Many of the nuggets exhibited were nearly pure gold. The gold had a crystalline structure, and was of fine yellow color. It was stated that in the district of North Carolina whence these nuggets were taken, gold was very abundant. The larger specimens were found in the gulleys, where they had been washed out of the decomposed rock, and it had been stated that a shovelful of dirt dug out of the hillsides anywhere in this vicinity would pan out traces of gold. Some years ago one man took out of a hole sixteen feet square $30,000 worth of gold. The quartzite containing the gold occurs in a white clay or decomposed schist.

December 11.

The President, Dr. Leidy, in the chair.

Thirty-three persons present.

On Extinct Rhinoceri from the Southwest.—Professor Cope exhibited the skull of a young rhinoceros, probably of the species *Aphelops fossiger* Cope, from the Loup Fork Bed of the valley of the San Francisco River, New Mexico. He also exhibited photographs of a mandibular ramus of a young rhinoceros, sent him by Dr. Mariano Barcena, of the City of Mexico. The ramus had been exhumed in the State of Mexico, and apparently belonged to a young individual of the *Aphelops fossiger*, but is of relatively small dimensions. Prof. Cope regarded the discovery as proving the existence of the Loup Fork formation at that locality.

A Fungus infesting Flies.—Prof. LEIDY directed attention to a vial filled with flies adherent to fragments of leaves. He stated that on the first of August, the last summer, he had noticed that from the swarm of flies that were attracted by the ripe fruit of a black mulberrry, *Morus nigra*, many settled on the under side of the leaves, and there became fixed and died from the invasion of a fungus, in the same manner as the house-fly often becomes attached to walls and window-panes, in the autumn, through the agency of the fungus known as the *Sporendonema*. The infested flies on the mulberry-tree were so numerous, that perhaps a fourth of the foliage of the lower boughs had from one to half a dozen of the flies adherent to each leaf. The fly, though a familiar one, is unknown by name to him. It resembles the house-fly, but is larger and has a black abdomen with lateral whitish spots. The fungus, of a fuscous hue, is especially evident in the extended intervals of the segments of the abdomen, along the sides of the thorax and at the neck. Though extending to and attaching the flies to the leaves, the specimens do not exhibit the zone of spores on the leaf as commonly seen in those of infested house-flies. Microscopic examination exhibited a similar structure of the fungus to that of the *Sporendonema* or *Empusa muscæ*. It mainly consists of translucent cylindrical, straight or somewhat tortuous rods or tubes of variable length with rounded ends, and containing homogeneous liquid with rows of oil-like globules. Mingled with the tubes are numerous oval, ovoid, and pyriform spore-like bodies, usually each with two oil like globules. The spore-like bodies measure 0·028 to 0·036 mm. long, by 0·016 mm. thick. The longer tubes measure usually up to 0·16 mm. long, by 0·012 mm. thick.

On Manayunkia.—Prof. LEIDY made some remarks on a specimen of *Manayunkia*, of which he exhibited a drawing, and which had been recently obtained by Mr. Edward Potts, from the mill-pond of Absecom Creek, at Absecom, N. J. It was of especial interest as apparently confirming the fresh-water habit of a cephalobranch annelide. The worm was contained in a tube attached to the midrib of a decayed leaf, to which there were attached several similar but empty tubes about one line long. The worm, 1·5 mm. long, appears to be an immature form of *Manayunkia speciosa*. The body consists of ten setigerous segments succeeding the head. The latter supports two lophophores, each with ten tentacles, of which none are conspicuously larger than the others. A pair of eyes occupy the head, but no pigment spots exist along the base of the tentacles. The podal setæ are from two to four, but mostly three, on each side of the segments. The podal hooks, but one on each side of the setigerous segments, except the first of the latter, which has none; and the last two, which have rows of six comb-like hooks on each side. The worm is translucent white, and the blood very pale green.

Ordinarily, Absecom pond is purely fresh water, and contains in abundance the usual plants and animals characteristic of fresh waters. Mr. Stuart Wood stated that in occasional extreme high tide of Absecom Creek, the pond had been subjected to the overflow of salt water.

How a Carpenter Ant Queen founds a Formicary.—Rev. Dr. McCook presented three specimens of fertile queens of the Pennsylvania carpenter ant, *Camponotus pennsylvanicus.* These had been given him by Dr. Joseph Leidy, who had taken them during the last summer at Wallingford, Delaware Co., Pa. The circumstances under which they were captured afforded a good demonstration of the manner in which a new colony of this and other species is begun, confirming the speaker's own observations and published statements. One specimen was taken, August 9, in a chestnut log; the others, August 14, in the stump of a chestnut-tree. They were enclosed within small cavities about an inch in diameter, and, curiously, the queens had sealed themselves within their nests by closing up the original opening by which they had entered, and from which, as a nucleus, they must have cut out their resident-room and nursery. If, therefore, they sallied forth to obtain food, as they may have done (for Dr. McCook had at various times observed queens wandering solitary), they must have removed the plug or "door," and restored it to place again upon re-entrance. However, he believed it to be quite within the bounds of probability that a well-fed queen could live without additional food for several weeks—a period long enough to rear a small brood, and also feed the larvæ from the contents of her crop, which might serve as a storehouse of food, as was explained by illustrations of the anatomy of the alimentary canal.

In the same receptacle with the queens were found (1) the white, oval or cylindrical eggs of the species; (2) larvæ of various sizes, from those just escaped out of the egg (2·3 mm. long) to full-grown (about 10 mm.); (3) the cocoons, or enclosed pupæ; and in one case (4) a callow antling, which had evidently just escaped from its case. This antling was, as indeed all the larvæ and cocoons appeared to be, of the dwarf caste. There are three castes in a formicary of *Camponotus*: the worker-major, the worker-minor and the minim, or dwarf. We may infer that the latter caste is the one which is first produced in rearing a family.

In response to a remark and suggestion made that the imperfect nurture given to the larvæ, under the peculiar circumstances, might account for the appearance of small workers first in order, Dr. McCook stated that, whatever one might conjecture to have been the fact in the remote origin of these castes among ants, it is certain that when the formicary has been fully peopled with workers, and the food-supply is unlimited, the several castes still continue to appear. Minims, minors and majors not only abound among the mature insects, but are found among the larvæ and cocoons. These

distinctions are a permanent feature of the ant economy; and while it is perhaps not permitted one to say that they are *not* caused by differences in amount or character of the nurture given in the larval state, yet this did not seem at all probable to the speaker. The fact that, in some genera, the workers have also remarkable differences in structure (as of the head, for example, in *Pheidole* and *Pogonomyrmex crudelis*) goes to show that differentiation into castes is regulated by something other than the food-supply.

The above observations are valuable as proving that the females of *Camponotus*, when fertilized, go solitary, and after dispossessing themselves of their wings, begin the work of founding a new family. This work they carry on until enough workers are reared to attend to the active duties of the formicary, as tending and feeding the young, enlarging the domicile, etc. After that, the queens generally limit their duty to the laying of eggs, and, as the speaker had elsewhere fully described,[1] are continually guarded and restricted in their movements by a circle of attendant workers, or "court."

The above facts are further illustrated and enlarged by a series of observations made by Mr. Edward Potts, in accordance with the speaker's suggestions and directions. On or about June 16, Mr. Potts captured a queen of *C. pennsylvanicus* running across his parlor floor, late at night. He placed it in a bottle, but forgot to examine it until five days later (21st and 22d June), when he was surprised to find that the ant was alive, and had laid six or eight eggs in the otherwise empty bottle; which eggs, in their various stages of development, she continued to attend for about fifty days. He fed the ant by dropping into her bottle a pinch of white sugar, which he moistened every evening with a drop or two of water; at which times she quit her otherwise unremitting watch over the eggs and the larvæ, to press her labium for a moment into the sweet fluid, her labial and maxillary palps meanwhile rapidly vibrating with pleasure. The egg-laying was, from the first, very deliberate; one or two eggs were added to the original stock from time to time, until about the 15th August, making the highest number counted, of all ages, nineteen.

He did not observe the date of the first hatching, but these larvæ, at first no larger than the eggs, and only distinguishable upon close observation by the slight grooves between the body segments and the ill-defined head, gradually at first, and afterwards more rapidly, reached finally a length of about one-quarter inch and began to spin their cocoons. On the morning of July 20, the first was surrounded by a single layer of web, but could still be seen working inside it. By evening the cocoon was too opaque to be seen through. On the morning of the 21st the

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[1] Proceed. Acad. Nat. Sci., 1879, p. 140; "Agricultural Ants of Texas," p. 144; "Honey and Occident Ants," p. 41.

second larva was covered in like manner, and the third by the evening of the 22d. For some days he was able to detect the dark form of the young ant in one of these cocoons, and on the evening of Aug. 11 a worker was running about the bottle and already essaying its ministrations upon the undeveloped eggs and the next series of larvæ, quite as big and much heavier than itself. We have, then, the period from, say June 20 to July 20 (thirty days), occupied in the development of the first eggs and the fulfilment of the larval stage; from July 20 to August 11, say twenty-two days, were spent in the pupa state.

The manner of the young worker was very nervous and far from soothing, especially to the well grown larvæ, who evidently much prefer a mother's care to that of an elder sister. He did not observe this antling feeding from the sugar, but upon one or two occasions saw osculatory advances towards its mother which seemed to indicate that it was not above receiving its nutriment from the maternal fount to which it became accustomed during its wriggling youth. It constantly climbed over the eggs and larvæ, apparently nipping them with its mandibles, but not moving them to any purpose. He saw no well-defined attempt at feeding them on its part; though, after patient observation, upon several occasions, he observed this act performed by the parent ant. She would caress the larva by sundry pats with her antennæ upon each side of the face, when, if hungry, it would lift up its head under her mandibles, placing its labium against hers, at which time a flow of liquid down the larval throat was seen.

As the queen's labors increased, she was less given to moving her charges from place to place, though they were not allowed to remain long quiescent. While nervously anxious about them, Mr. Potts thought that she showed little evidence of tenderness in her treatment, trampling on them with her feet or dragging them around under her heavy abdomen, as if they were really the putty they looked like.

The moisture necessary for the cleansing and growth of the larvæ was apparently supplied from the tongue of the caretaker, who examined them one after another, moistening the dry places and keeping the egg and larval skins flexible. The queen was very careful of the eggs, standing nearly all the time with her head over the little heap, occasionally picking them up to move them a quarter of an inch or more to one side. She was thrown into a great excitement of solicitude when a fly, attracted by the crumbs, intruded within her domicile. She sprang fiercely at the fly and raged around her narrow compartment, seizing a group of eggs as if to escape with them from a threatened danger, then replacing them as though recognizing the impossibility of getting away. Her demeanor on this occasion indicated strong maternal solicitude.

Mr. Potts made some attempt to follow the embryonic changes, and made a few drawings of the different phases. When first

seen the egg is full of fluid, uniform in appearance throughout. When next observed segmentation had taken place and advanced to the morula stage, showing everywhere small granular cells of uniform size. Afterward a hyaline spot appears at one end of the egg, which there seems empty or filled with a homogeneous fluid; next to which are large cells, containing smaller ones of various sizes. Later both ends become transparent, the large cells bounding the small-celled body-cavity and forming the well-known gastrula condition. He was not able to trace the formation of the various internal or external organs. The cyclosis or pulsation of the larval heart was counted in two instances at 45 and 50 per minute.

The manner of ovipositing (August 13) the nineteenth egg is thus described: When first observed the queen stood up high upon all three pairs of legs, the abdomen thrown forward between them and the head bent back almost to meet it. The egg was then about half protruded. Considerable muscular action was visible throughout the abdomen, and when presently the egg was posited she straightened herself out with a visible air of relief, but forgot all about the egg, which was left lying under her for several minutes while she attended to other matters, until at last, accidentally touching it with one antenna, she picked it up and carried it to the family apartments, where, presently, the worker found it and placed it in the group of the older eggs. An evident intent at classifying the eggs and larvæ was remarked, these (within the narrow limitations of the chosen space) having been kept to a good degree separate.

August 13, another worker was released from its cocoon. Mr. Potts did not see the act, but believed that the female assisted, as she was seen standing over the neophyte who seemed to be weak, its femora bent forward, the tarsi and tibiæ still nearly reaching the end of the abdomen, indicating the manner in which the legs were folded in the cocoon. Immediately after release the mother gave the young imago nourishment in the manner above described.

At this date there were in the formicary, beside the mature ants, two full-grown larvæ, very fat, two about half-grown, and several smaller ones, with the eggs in different stages of development. The two oldest were then evidently about ready to spin, but what chance they could have, with the mature ants continually tramping over them, standing them up on end or hauling them off to a distance, Mr. Potts was at a loss to imagine. From the mouth of one he observed a strand of silk protruding, but the workers came, apparently trying to grasp it, and left him in doubt whether their object was to help or hinder the weaving process.

August 14, one of the two full-grown larvæ was found wrapped in its winding sheet. The web was very thin and the motion of the larvæ readily seen through it. The other larva seemed almost totally quiescent, but careful examination with a Coddington lens showed some muscular action in the posterior segments of

the body. Their state of comparative torpor was thought to immediately precede the act of spinning. At this date the workers had become less nervous in their motions, and the female seemed to have resigned most of her labors to them, resting much of the time quietly in one place.

August 16, the third worker had emerged and was found quite at home in attending to its duties. The second grown larva was then still uncovered and quiescent. Very close observation was required to show that it still breathed, and it made no other visible motion.

These observations of Mr. Potts establish or confirm the following points: (1) The manner of depositing the eggs, which, as well as the larvæ, are cared for by the queen until workers are matured; (2) the stages in the development of the egg and larvæ are partially noted; (3) the time required for the change from larval to pupal state is about thirty days; (4) about the same period is spent in the pupa state, the entire period of transformation being about sixty days; (5) the work of rearing the first broods of *Camponotus* begins the latter part of June or early in July; (6) about twenty-four hours are spent by larvæ in spinning up into cocoon; (7) the ant queen probably assists the callow antling to emerge from its case; (8) not only the larvæ, but occasionally also the antlings, are fed by the queen; (9) the young workers, shortly after emerging, begin the duty of nurses, caring for the eggs and tending the larvæ. Some of these points thus abstracted and formulated by him Dr. McCook was subsequently able to confirm from observations upon the same queen. His thanks were due Mr. Potts for the intelligent and successful manner in which his suggestions had been carried out.

The following was ordered to be printed :—

A STUDY OF THE DISTRIBUTION OF GLUTEN WITHIN THE WHEAT GRAIN.

BY N. A. RANDOLPH, M. D.

The object of the present paper is to briefly describe several methods for the demonstration of gluten in the central portion of the wheat grain, and the results of their application.

For many years the great majority of observers and of writers upon gluten have stated that this highly important nitrogenous element of food is found almost, if not quite exclusively, in the fourth layer (Parkes) of the grain, immediately below and adherent to the third or inner coat of the true bran; this fourth layer is composed of closely packed yellowish granular cells of ovate or cuboid form, each of which is provided with a dense, laminated cellulose wall and contains a large proportion of free fat. Immediately within this layer of so-called "gluten-cells," and constituting the greater portion of the grain, is an aggregation of much larger, usually elongated, cylindrical cells, whose contents are *apparently* made up exclusively of starch granules which exhibit great diversity in size.

So fixed and widespread has the belief become that the gluten of the wheat resides in specific cortical cells of the grain, that not only do many most intelligent persons habitually rasp their digestive surfaces with branny foods, but attempts to determine, by microscopical examination, the nutritive values of various prepared foods have been made, in which the proportion of "gluten-cells" found in a given food formed the criterion of its value.[1] These assumptions have called forth merited criticism from Prof. Richardson, of this city, and from Prof. Leeds, of Hoboken, both of whom emphasized the fact, singularly ignored by Cutter, Jacobi and their followers, that ordinary white wheat-flour contains a varying but always notable quantity of gluten.

So far as the writer is informed, however, there has not been recorded any ocular demonstration of the gluten of the wheat grain, *in situ* and entirely independent of the "gluten-cells." Such a demonstration may be conclusively made by either of the following methods:

1. If whole wheat grains be macerated in water to which a few

[1] E. Cutter, M. D., Galliard's Med. Jour., Jan., 1882.

drops of ether have been added to prevent germination, they will, in a few days, become thoroughly softened, and the contents of such a grain may then be squeezed out as a white tenacious mass. Examination of the remaining bran shows the "gluten-cells" undisturbed, closely adhering to the cortical protective layers. By now carefully washing the white extruded mass, the major part of its starch may be removed; and upon the addition of a drop of iodine solution, microscopic examination shows numerous networks of fine yellow fibrils, still holding entangled in their meshes many starch granules colored blue by the iodine. In carefully washed specimens, these sponge-like networks are seen to retain the outline of the central starch-filled cells, and evidently constitute the protoplasmic matrix in which the starch granules lay. Upon gently teasing such a specimen under a moderate amplification the fibrils will be seen to become longer and thinner in a manner possible only to viscid and tenacious substances—a class represented in wheat by gluten alone.

An eminently satisfactory proof of the proteid nature of these central networks may be obtained by heating the specimen in the solution of acid nitrate of mercury (Millon's reagent), when the fibrils will assume the bright pink tint characteristic of albumenoids under this treatment. The results of the application of the xanthoproteic and biuret reactions are equally conclusive, but more care is required in the use of these proteid tests, and the resultant differentiation is not so clear. Reticuli similar to those above described, but much broken and smaller, may be seen, upon close examination, scattered throughout fine white flour, without the addition of any reagent.

By general consent, the albumenoids of the wheat grain are grouped together as gluten, which is, however, further separable into gluten-fibrin, gliadin and mucedin, proteid bodies practically equal in nutritive value, but differing in certain physical properties, notably that of solubility. It must, therefore, be borne in mind that in this, as in all other methods of separating gluten from the other constituents of the grain, its relatively small soluble portion is removed with the starch, and that any estimate of the quantity of gluten based upon such methods will probably be rather under than over the actual amount.

2. In even the thinnest sections of the wheat grain, the gluten of the central portion is always masked by large numbers of starch

granules. These may, to a large extent, be removed by immersing the section for a short time in liquor potassæ, with subsequent careful washing. The alkali affects the hydration and partial solution of the starch; but if its application be too long continued, the gluten will also be dissolved. This treatment is well adapted to show the rather dense gluten networks usually found in bran, immediately below the fourth layer.

3. The most satisfactory method of studying the distribution of gluten in sections of wheat is that of *artificial salivary digestion*. If the section be gently boiled for a moment to hydrate the starch, then transferred when cool to filtered saliva, and maintained for from half an hour to an hour at a temperature of about 98° Fahr., all the starch will be digested away, while the insoluble proteid and other constituents will remain entirely unaltered. A section of wheat grain thus treated will exhibit, throughout its entire central portion, close-meshed gluten networks, which become slightly denser toward the cortex of the grain. The proteid character of these reticuli is here, as in the first method, susceptible of micro-chemical demonstration by Millon's reagent or the biuret reaction. A relatively very faint coloration, indicating the presence of albumenoids, is noticeable in the "gluten-cells," while the gradual condensation of the gluten of the endosperm as the cortex is approached, is evidenced by a quite vivid coloration of the fibrils.

Schenk[1] has applied Millon's reagent to sections of wheat with a resultant assumption by the endosperm of a pink tint and "no coloration of the cortical gluten-cells." The starch was not removed and the method of distribution of gluten was not determined. By artificial gastric digestion of wheat sections, the same observer noted that the starch of the section became readily detached, and deduced from this the just proposition that the gluten lay between the starch granules.

Objections are not infrequently offered by the chemist to the microscopical determination of organic compounds, especially where any attempt at a quantitative estimation is made. All that is claimed for the methods above described is the demonstration of gluten in very considerable quantity in the inner layers of the wheat grain. It is but just to state, however, that by these methods a conception may be obtained of the quantity of proteids

[1] Anat.-Physiol.-Unters., p. 32. Wien., 1872.

within the grain fully as accurate as that given by the usual chemical method of estimating the albumenoids of a given body, namely, from the entire amount of nitrogen contained in it. Especially is this true in the case of vegetable tissues. In a close analysis of the potato, Schultze and Barbieri found that only 56·2 per cent. of all its nitrogen existed in albumenoid combination, while in the fodder-beet only 20 per cent. of the nitrogen went to the formation of albumenous compounds; the remainder in each case entering into the composition of non-nutritious bodies, as amides, nitrates, ammonia and asparagin.

The fact that the gluten networks become denser toward the periphery of the endosperm, together with the presence of non-albumenoid nitrogenous compounds in the perisperm, explains the notable percentage of nitrogen found in bran as ordinarily roughly removed.

The color tests mentioned above indicate that the amount of proteids contained in the cells of the fourth layer is relatively very slight; but admitting for the moment that these cells contain gluten, the question naturally arises whether, in view of their dense cellulose walls, they are capable of serving as a food-stuff for man. In artificial digestions the writer has found these elements, even when thoroughly cooked, to be unaffected by the digestive juices; that is, well-boiled bran with its adherent "gluten-cells," will sustain prolonged maceration at the temperature of the human digestive tract in artificial gastric and pancreatic juice (in which, under the same conditions, fibrin is readily digested) without exhibiting any change. These cells were further found to be unaffected by maceration for thirty days in liquor potassæ, except for a slight swelling of the cell and the occasional coalescence of some of its contained oil-globules. They were also practically unchanged by a few days' immersion in strong nitric acid. In order to obtain conclusive and unassailable results as to the nutritive value of the "gluten-cells" as far as man is concerned, the writer has at present under observation a number of healthy adults, who daily receive, in addition to their regular diet, a small fixed amount of boiled bran. Their alvine dejections (containing all the undigested elements of food after the normal action of all the digestive juices) will be submitted to close microscopical examination, with a view to ascertaining the extent to which the "gluten-cells" have been digested, and a report will be made upon the results in the near future.

DECEMBER 18.

The President, Dr. LEIDY, in the chair.

Sixty-two persons present.

A paper entitled "Reproduction in Amphileptus fasciola," by Andrew J. Parker, M. D., was presented for publication.

Miss Adele M. Fielde made a communication on the language, literature and folk-lore of China.

DECEMBER 25.

Rev. HENRY C. McCOOK, D. D., Vice-President, in the chair.

Fifty persons present.

The following was ordered to be printed:—

REPRODUCTION IN AMPHILEPTUS FASCIOLA.

BY ANDREW S. PARKER, M. D., PH. D.

Several years ago, while examining some infusoria, I noticed a specimen of *Amphileptus fasciola* undergoing some curious changes, the nature of which, at that time, I did not fully appreciate, supposing them to be due to the dissolution of the animal. Recently I observed the same series of phenomena occurring in another individual, and on tracing them out more fully I found that they were due, not to the death of the infusorian, but to what I believe is a method of reproduction not hitherto observed, or at least not described, in this group. My attention, in both instances, was attracted by a peculiar oscillating movement, the *Amphileptus* rocking from side to side, the animal remaining stationary, although its cilia were in active motion. In other respects the animal appeared normal, no changes being observed in its nucleus, protoplasmic contents or contractile vesicle. Shortly after I had noticed this peculiar rocking movement I found that the elongated extremity was breaking up into small masses of protoplasm; these gradually separated from the parent body, and each of them exhibited distinct amœboid movements. Although the cilia seemed to break off with the small masses, I could not detect any signs of their presence after separation. For about five minutes small protoplasmic masses, exhibiting distinct and independent amœboid movements, continued to be shed.

The rocking movement still continued, but now commenced to show signs of being converted into a movement of rotation. Finally a rotary motion was established, and the animal commenced to change its position. At the same time I noticed a distinct elongation occurring at the end where the changes described above had taken place, a rounded projection appearing, which gradually elongated, until finally, in the course of about two hours, the individual had assumed its original shape and activity, although apparently somewhat diminished in bulk. Cilia covered the new growth, but they did not seem to be a new formation, but were produced by a simple elongation of the ectosarc, this being carried forward by the growing endosarc. As regards the protoplasmic masses that were shed or discharged, I observed them for about four hours, at which time they were still

active, and the parent mass still in active motion. On the following day I was unable to detect them, and as to their subsequent history I know nothing.

To characterize the phenomena as described above, I propose the term "Reproduction by Partial Dissociation." Reproduction by fission, gemmation, conjugation and encystation have all been observed in the ciliated infusoria; and some of the older writers, such as Ehrenberg and others, have described a mode of increase, in which the substance of the body breaks up into a number of fragments, each of which is capable of becoming a distinct individual. This process they called diffluence, but Stein and other more recent observers have denied the existence of this process, claiming that it was merely a form of increase from encysted forms. The phenomena as exhibited by *Amphileptus fasciola* seem to be quite different from those described as occurring in diffluence, and it certainly was not a case of encystation. I have been unable to find any account of reproduction in the infusoria resembling that described above, and I therefore place the facts on record, in order that the attention of other observers may be directed towards the verification of the phenomena and views expressed above.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending November 30, 1883, twenty-four members and seven correspondents have been elected.

Resignations of membership have been received from the following, and accepted on the usual conditions:—Wm. John Potts, G. B. Cresson, Isaac S. Williams, Howard A. Kelly, M. D., John Wagner, W. G. Audenried, Charles W. Pickering, Wilson Mitchell, H. W. Workman and R. S. Peabody.

The deaths of fourteen members and seven correspondents have been announced and duly recorded in the printed Proceedings.

Thirty-five papers have been presented for publication, as follows: Edw. D. Cope, 7; Jos. Leidy, 3; Angelo Heilprin, 3; S. B. Buckley, 1; H. T. Cresson, 1; B. W. Everman and S. E. Meek, 1; S. G. Foulke, 1; Andrew Garrett, 1; Josiah Hoopes, 1; David S. Jordan, 1; Alexis A. Julien, 1; H. Carvill Lewis, 1; Graceanna Lewis, 1; Isaac C. Martindale, 1; Rev. H. C. McCook, 1; Charles L. Mitchell, 1; Henry F. Osborn, 1; Benjamin Sharp, 1; Theo. D. Rand, 1; Jos. Swain, 1; Jos. Swain and Geo. B. Kalb, 1; R. E. C. Stearns, 1; Chas. H. Townsend, 1; Jos. Willcox, 1; Berlin H. Wright, 1. One of these was withdrawn by the author; two of those by Dr. Leidy and the one by Mr. Garrett were accepted for publication in the Journal, and the others have been or are about to be issued in the Proceedings.

One hundred and fifty-nine pages of the Proceedings for 1882 and two hundred and thirty-two pages of the volume for 1883 have been published. The latter is illustrated by eleven plates. Sixty-eight pages of the Journal, Vol. IX, Part I, have also been printed. These include Dr. Leidy's paper on Urnatella gracilis, advance copies of which were issued by the author early in December of the present year, and about half of Mr. Garrett's paper on Society Islands Shells. The former is illustrated by one fine chromolithographic plate, and the latter by two plain lithographs, containing one hundred and fifty-two figures.

One hundred and twenty-one copies of the Proceedings have been distributed to subscribers. Fifty-nine copies have been sent to domestic, and three hundred and thirteen to foreign journals and societies. The exchange list has been carefully revised,

several societies from which we have not received anything for more than five years having been dropped, while a number heretofore omitted have been added. It has always been the practice of the society to send its publications to a number of important foreign Universities and town libraries, situated in places not otherwise in receipt of the Proceedings and Journal, so that students everywhere may be able to inform themselves of the Academy's contributions to science. These intellectual centres have been supplied with the current numbers of the Proceedings as usual.

A circular distributed to corresponding societies in July, asking them to send their publications to the Academy by post, in exchange for a like prompt transmission on our part, has not been productive of as much result as was hoped for. An early distribution of the Proceedings is, however, of so much importance, both to the contributors and to the society at large, that each number will be mailed, hereafter, to exchanges as well as to subscribers, as soon as possible after its issue from the press.

The average attendance at the meetings during the year has been thirty-one. Verbal communications have been made by twenty-six members and two guests. Much the greater number of these have been prepared by the authors for publication in the Proceedings, and form not the least important part of the annual volume, while abstracts were made for the public press of those which could at all be regarded as of popular interest.

Art. 6, Chap. X, of the By-Laws was amended on November 27 by striking out from the first line the word "only," and from the second and third lines the words "obtain permission to." Art. 6, Chap. XI, was amended at the same meeting by striking out all after the word "public" in the second line, and inserting in lieu thereof "daily, except Sunday, and at least one day in the week without charge on such conditions and under such regulations as the Council shall establish from time to time."

Dr. Ruschenberger having been elected a Curator at the annual election in 1882, thereby became ex-officio a member of the Council; Mr. Charles Morris was elected to fill the vacancy thus created in the latter body. At the meeting of the Council held February 17, the Curator-in-charge, Mr. Chas. F. Parker, was granted a month's leave of absence in consequence of an indisposition, which it was then hoped was but temporary. It was found

necessary, however, to renew the leave of absence from time to time until his death on the 7th of September. Earnest testimony to his worth as a man and to the value of his services to the Academy has been already borne by his associates, and the general feeling of the society has been well expressed in the able biographical notice by his friend and fellow-member, Isaac C. Martindale, published in the Proceedings of November 13.

At the meeting of the Academy held October 2, Prof. Angelo Heilprin was elected Curator, to fill the vacancy caused by the death of Mr. Parker; and at the meeting of the Council held on the 5th of October he was appointed Curator-in-charge, or Actuary to the Curators.

An inquiry from the New Century Club, as to the desirability of endowing a professorship in the Academy, to be held exclusively by women, having been referred for consideration to the Council, it was resolved that, inasmuch as the professorships are open to women, as well as men, it is inexpedient to restrict any professorship to either sex. This action of the Council was endorsed by the Academy and transmitted to the New Century Club, with the suggestion that if a proposition were made to endow a scholarship for women instead of a professorship, the subject might receive further consideration.

A committee, consisting of Messrs. Valentine, Corlies, Ruschenberger, Frazer and Whelen, was appointed January 2, to petition the Legislature of Pennsylvania to aid the Academy in the extension and furnishing of its building. The efforts of this committee have been so far unproductive of result, although by action of the Legislature the collections of the Second Geological Survey of Pennsylvania are now stored in boxes in the cellar of the Academy. Their value to the student would be, of course, greatly enhanced if they were properly displayed. The Academy is, however, entirely unable at present to furnish the space necessary for such exhibition, and the request to the Legislature for aid in the construction of an addition to the Academy, in which these collections would be properly placed, cannot be deemed unreasonable.

The most important additions to the Academy's possessions made during the year have been the Wm. S. Vaux collections of minerals and antiquities. After mature consideration by the Council and the Academy, the conditions proposed by the executor

for the government of the bequest were finally adopted at the meeting held February 20. A special appropriation was made for the alteration of the entresol rooms at the east end of the hall, for the accommodation of these collections, and therein they have been arranged by Mr. Jacob Binder, the special curator appointed by the Council in conformity with the articles of agreement. Mr. Binder's report, which follows that of the Professor of Mineralogy, indicates the character and extent, as well as the mode of arrangement, of the collections under his charge.

At the meeting held April 24, the following was adopted:—

Resolved, That the title to certain lands in Western Virginia, belonging to the Academy, and heretofore held in trust therefor by the late Wm. S. Vaux, be vested in Messrs. T. D. Rand, Jacob Binder and S. Fisher Corlies, as trustees for the Academy, and that the title to a burial lot, owned by the Academy in the cemetery adjoining the Academy's premises on Race Street, be transferred to the Trustees of the Building Fund, in accordance with the recommendation of the Council, March 26, 1883.

The American Association for the Advancement of Science has accepted the invitation tendered by the Academy, in conjunction with other educational establishments, the officers of the municipal government and prominent citizens, to meet in Philadelphia in 1884. It is hoped that the meeting may be attended by the British Association which meets in Montreal next August, or at least by an important representation thereof. The International Electrical Exhibition, which it is proposed to hold at the same time under the patronage of the Franklin Institute, cannot fail to add largely to the interest of the occasion and to the number of those in attendance. The result will probably be one of the largest scientific meetings ever held, and one which cannot fail to exert a beneficial influence on the Academy in common with the other scientific institutions of the city. We have, therefore, abundant reason to hope that the prosperity of the society at the end of next year will be at least as great as that so clearly set forth in the accompanying annual reports of officers and sections.

All of which is respectfully submitted,

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

The Corresponding Secretary reports that the business of his office presents but little variation from that of preceding years.

There have been many favorable replies received from corresponding societies to our request for an interchange of publications by mail, the result of which will be an earlier acquaintance with the doings of other societies, greatly to the advantage of working naturalists.

The Museum has received many additions during the year, a detailed account of which will appear in the Curator's report. These have been promptly acknowledged, to the number of 119.

There have been seven Correspondents elected during the year, and acknowledgment has been received from but one who was elected during the present year.

Our corresponding societies generally acknowledge the reception of our publications by letter, and accompany their own publications with letters of transmission.

Letters of acknowledgment have been received numbering,	67
Letters transmitting publications have been received numbering,	42
Letters concerning postal interchange numbering,	19
Ackowledgments from Corresponding Members,	1
Miscellaneous correspondence,	21

In the latter number are many asking for deficiencies in their series of our publications. These have been favorably responded to whenever possible. There has been a considerable accession to our exchange list during the current year.

Respectfully submitted,

GEORGE H. HORN, M. D.,

Corresponding Secretary.

REPORT OF THE LIBRARIAN.

During the twelve months ending November 30, 1883, 3003 additions have been made to the library, an increase of 208 over the growth of 1882. These additions have consisted of 360 volumes, 2615 pamphlets and separate parts of periodicals, and 28 maps, sheets, photographs, etc.

The above increase has been derived from the following sources :—

Societies,	1113
Editors,	816
I. V. Williamson Fund,	437
Authors,	255
Joseph Jeanes,	83
Thomas B. Wilson Fund,	49
University of Würzburg,	27
Department of the Interior,	22
Geological Survey of Sweden,	22
Smithsonian Institution,	20
Department of Agriculture,	19
Dr. Frances W. Wetmore,	16
Geological Survey of Portugal,	13
F. V. Hayden,	11
Geological Survey of India,	10
War Department,	9
Geol. Survey of Pennsylvania,	8
Regents of the University of New York,	7
J. H. Redfield,	6
Minister of Public Works, France,	5
Treasury Department,	5
Engineer Depart., U. S. A.,	5
Norwegian Government,	5
British Museum,	3
Geological Survey of New Zealand,	3
Geol. Survey of Wisconsin,	3
Stephen G. Worth,	3
Navy Department,	2
Geological Survey of Belgium,	2
J. S. Newberry,	2
Department of Mines, Nova Scotia,	2
Geological Survey of Newfoundland,	2
East Indian Government,	2
S. F. Corlies,	2
Thomas Meehan,	1
Trustees of the Indian Mus.,	1
Trustees of the S. African Mus.,	1
Rev. H. C. McCook,	1
David L. James,	1
Cobden Club,	1
Geological Survey of Illinois,	1
O. A. Derby,	1
Trustees of the Boston City Hospital,	1
F. v. Mueller,	1
U. S. Coast Survey,	1
Surgeon General's Office,	1
U. S. Commission of Fish and Fisheries,	1
Executor of the late Wm. S. Vaux,	1

The several lots have been presented on the Tuesday evening following their reception, and distributed to the departments of the library as follows, each title being immediately added to the card catalogue :—

Journals,	2225
Geology,	202
Conchology,	85
General Natural History,	82
Botany,	60
Entomology,	46
Bibliography,	33
Voyages and Travels,	25
Mammalogy,	25
Agriculture,	20
Anatomy and Physiology,	18
Helminthology,	18
Mineralogy,	17
Ornithology,	17
Anthropology,	12
Ichthyology,	10
Encyclopædias,	10
Chemistry,	10
Physical Science,	9
Education,	9
Herpetology,	2
Medicine,	2
Miscellaneous,	66

154 volumes have been bound, and an additional 135 are still in the hands of the binder.

Assistance furnished me during the summer months has enabled me to have the books and pamphlets on Conchology, Physical

Science, Chemistry, Geography and Medicine, together with the Italian journals, added to the card catalogue. The Department of Conchology had not been before included in the card entries, because a complete hand catalogue had been prepared just before the card system was adopted, and a similar arrangement of the other departments mentioned has not heretofore been possible for lack of time. I regret to say that, for the same reason, the American and Italian journals only have as yet been completely catalogued, although the hand index to the shelf arrangement, in use for several years back, has been kept roughly up to date, and serves its purpose reasonably well. Every effort will be made during the coming year to complete the catalogue of this department.

A circular which was sent to all our corresponding societies, proposing an exchange of publications by mail, has been answered favorably by a few societies, but the greater number seem to prefer sending but once a year, as heretofore, through the International Exchange Bureau. This is to be regretted, as early access to the current scientific literature is of the utmost importance to the student. Of course, the many journals for which the Academy subscribes, and which are all credited in the accompanying list to the I. V. Williamson Fund, are received promptly by mail as issued.

It will be observed that we are indebted to the liberality of Mr. Joseph Jeanes for 83 of the current additions, and to the fund which the Academy has received from Mr. Isaiah V. Williamson for 437 volumes and continuations of periodicals. These additions are of special value and importance, as they have been ordered at the request of the working members, and supply for the most part the material required for actual investigation.

A fine portrait in oil of Dr. Joseph Leidy, by Uhle, has been placed on permanent deposit by the Biological Club of Philadelphia. The amount required for the portrait of Dr. Robert Bridges having been secured, the order was given to Mr. Uhle early in the year. I regret to say the artist's engagements have not enabled him to complete the work, which will, however, be placed in the library at an early date.

All of which is respectfully submitted,

EDWARD J. NOLAN,

Librarian.

REPORT OF THE CURATORS.

The Curators present the following statement of the Curator-in-charge, Prof. Angelo Heilprin, as their report for the year ending November 30:—

The condition of the Academy's collections, although it cannot be stated to be absolutely satisfactory, is yet fairly good when compared to the condition of similar collections in this country, or even of those pertaining to foreign institutions. Much, however, remains to be done before either the interests of science or of general education will have been thoroughly satisfied, and until more efficient aid is added to the working power of the Academy, progress towards the obtaining of this satisfied condition must be necessarily slow. The great obstacle in the way of the systematic arrangement of the collections has thus far been, and still remains, want of space, a weighty obstacle which must ever remain as such until greater expansion will have been afforded in the construction of an extension to the present building.

The removal, at a very moderate expense, of the large central platform on the floor of the museum has permitted of a much more satisfactory arrangement of the extensive series of geological and palæontological specimens than has heretofore been possible, and has at the same time afforded room for the gathering together and proper exhibition of a special collection—namely, a collection illustrative of the natural products of Pennsylvania and New Jersey. In this "local museum," as it may be termed, it is intended to illustrate by actual specimens (as far as is practicable) the entire domains of zoology, palæontology, geology and mineralogy, in so far as these departments are directly connected with the States above mentioned, and thereby very materially facilitate the means for self-instruction in natural history, and for making such immediate examinations and comparisons as may be variously demanded. Work in the arrangement of this collection has been progressing favorably, and it is hoped that the entire exhibition will be satisfactorily displayed in the early part of the coming year.

The most important addition made during the past year to the Academy's museum is the Vaux collection of minerals and archæological implements, to which reference is made in the report of

the special Curator appointed for those collections, Mr. J. Binder, by whom the specimens have been carefully arranged and classified. The other additions to the museum are recorded in the list of donations herewith appended, or are incorporated in the reports of the different sections.

The Academy has during the year benefited through the services of three Jessup Fund beneficiaries, Messrs. J. Wortman, A. F. Gentry, and S. F. Aaron, respectively in the departments of vertebrate palæontology, ornithology, and entomology, the first of whom has latterly resigned on receiving the appointment of assistant to the Curator-in-charge. An application for the filling of the present existing vacancy in the Jessup Fund is now in the hands of the Curators.

JOSEPH LEIDY,
Chairman of the Board of Curators.

SUMMARY OF THE REPORT OF THE TREASURER,

FOR THE YEAR ENDING NOV. 30, 1883.

DR.

To Balance from last account	$ 991 81	
" Initiation fees	170 00	
" Contributions (semi-annual contributions)	2000 58	
" Life Memberships	500 00	
" Admissions to Museum	457 17	
" Sale of Guide to Museum	40 00	
" Sale of duplicate books	8 58	
" Sale of Proceedings, Journals, etc	430 91	
" Fees, Lectures on Palæontology	136 00	
" Fees, Lectures on Mineralogy	189 00	
" Wilson Fund. Toward Salary of Librarian	300 00	
" Interest on Money awaiting investment	722 17	
" Interest on Deposits in Trust Companies	8 94	
" Interest from Mortgage Investment, Joshua T. Jeanes' Legacy	1000 00	
" Publication Fund. Interest on Investments	265 89	
" Barton Fund. " " "	240 00	
" Life Membership Fund. " " "	132 50	
" Maintenance Fund. " " "	102 50	
" Eckfeldt Fund. " " "	66 86	
" Museum Fund. " " "	25 00	
" Stott Legacy Fund. " " "	67 50	
		$7849 36

Cr.

Salaries, Janitors, etc.		$3858 21	
Printing Proceedings	$601 16	724 41	
Binding "	123 25		
Repairs		698 17	
Printing and Stationery		85 61	
Binding		58 75	
Freight		31 13	
Plates and Engravings		109 50	
Water Rents for 1883		26 15	
Postage		127 55	
Coal		616 70	
Gas		120 67	
Miscellaneous		457 06	
Newspaper Reports		86 00	
Insurance		30 00	
Ice		7 44	
Trays		18 10	
Alcohol		23 50	
Cases		23 00	
A. Heilprin, Lectures on Palæontology		136 00	
H. C. Lewis " " Mineralogy		189 00	
Guides to Museum		23 00	
Books		164 57	
Vials		8 25	
Life Memberships transferred to Life Membership Fund		500 00	
			$7622 77
Balance, General Account			$226 59

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement		$1300 00
Life Memberships transferred to this account		500 00
Interest on Investments		132 50
		$1932 50
Transferred to General Account	$ 132 50	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1432 50
To Balance for Investment		$500 00

BARTON FUND. (For Printing and Illustrating Publications.)

Interest on Investment	$240 00
Transferred to General Account	240 00

JESSUP FUND. (For Support of Students.)

Balance, last Statement	$711 67
Interest on Investments	560 00
	$1271 67
Disbursed	676 66
Balance	$595 01

MAINTENANCE FUND.

Balance per last Statement		$2108 14
Interest on Investments		102 50
		$2210 64
Transferred to General Account	$ 102 50	
Investment in Bond and Mortgage at 5 per cent. Interest	2100 00	
		2202 50
To Balance for Investment		$8 14

PUBLICATION FUND.

Balance, last Statement		$1214 70
Income from Investments		350 69
		$1565 39
Transferred to General Account	$265 39	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1565 39

MRS. STOTT FUND. (For Publications.)

Balance, last Statement		$1300 00
Interest from Investments		67 50
		$1367 50
Transferred to General Account	$ 67 50	
Investment in Bond and Mortgage at 5 per cent. Interest	1300 00	
		$1367 50

I. V. WILLIAMSON LIBRARY FUND.

Balance, last Statement		$433 48
Rents collected		835 27
Ground-rents collected		1026 28
		$2295 03
For Books	$814 60	
Binding	76 25	
Repairs to Properties	229 68	
Taxes and Water Rents	241 97	
Transfer of Property to Academy	69 05	
Collecting	93 07	
		$1524 62
Balance		$770 41

THOMAS B. WILSON LIBRARY FUND.

Balance overdrawn per last Statement	$232 89
Dulau & Co., London	51 88
B. Westermann & Co., Books	162 78
Transferred to General Account	300 00
	$747 55
Income from Investments	525 00
Balance overdrawn	222 55

ECKFELDT FUND.

Balance, last Statement		$966 86
Interest from Investments		100 00
		$1066 86
Transferred to General Account	$ 66 86	
Investment in Bond and Mortgage at 5 per cent. Interest	1000 00	
		$1066 86

BOOK ACCOUNT. (Donations from Jos Jeanes, Esq.)

Balance, last Statement	$339 83
Less cash paid for Books	302 70
Balance	$37 13

BINDING ACCOUNT. (Donations from Jos. Jeanes, Esq.)

Balance, last Statement	$277 85
Less cash paid for Binding	277 85

INSTRUCTION FUND.

Balance, last Statement	$60 00
Less cash paid for Cards	4 00
Balance	$56 00

MUSEUM FUND.

Balance, last Statement		$1000 00
Interest from Investments		25 00
		$1025 00
Transferred to General Account	$ 25 00	
Investment in Bond and Mortgage at 5 per cent. Interest	1000 00	
		$1025 00

WILLIAM S. VAUX COLLECTION FUND.

Cash received from Estate of Wm. S. Vaux, deceased		$1000 00
Interest from Investments		1000 00
George Vaux, for Mineral Case		50 00
Cash received from Sale of Five Cases		250 00
		$2300 00
Cash paid for Cases	$1469 50	
Cash paid for Miscellaneous Expenses	401 66	
		1871 16
Balance		$428 84

Also received the legacy of William S. Vaux, deceased, which was paid in ten bonds for one thousand dollars each (total, ten thousand dollars), of the seven per cent. Registered Mortgage Bonds of "The Philadelphia and Reading Coal and Iron Company." The interest of these Bonds to be applied to the use of the "William S. Vaux Collection Fund."

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

During the year eighteen meetings were held, with an average attendance of about fifteen persons.

The annual exhibition was held April 5, and was a success as to the number of visitors and in regard to the improvement noticed in general microscopical manipulation.

The following gentlemen became contributors to the Section during the year:—Dr. L. Brewer Hall, Dr. Henry Beates, Dr. Max Bochroch, Dr. Charles L. Mitchell, Dr. M. B. Hartzell, Dr. Arthur Wilson, Dr. William R. Hoch, Mr. John F. Lewis.

The following resignations were accepted:—Dr. Charles Turnbull, Dr. S. H. Guilford.

The meetings have been well supplied with material for discussion, and an increased interest has been manifested during the year.

The following are some of the more important subjects brought to the notice of the Section:—

Dr. J. G. Hunt.—Communication upon Diatomes, Desmids, Sponges, Carnivorous Plants, Mosses and on the Preparation of Animal and Vegetable Tissues.

Dr. Charles Mitchell.—A New Freezing Microtome. Also a paper upon Hæmatoxylon Staining.

Dr. L. B. Hall.—Communication upon Spirogyra.

Dr. G. A. Rex.—Upon the Trichias, with two rare forms not found before in North America.

Respectfully submitted,

ROBERT J. HESS, M. D.,

Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that of the various papers upon the subject of the Mollusca, accepted for publication by the Academy during the past year, the most important was one by Mr. Andrew J. Garrett, of Tahiti, upon "The Land Shells of the Society Islands," which is now in press and will soon appear as a part of the Journal.

It is with sincere regret that we record the death of our valued member, Mr. Charles F. Parker, which occurred September 7, 1883. Mr. Parker was one of the founders of the Section, and a very large portion of the leisure time at his command was devoted to its interests. In his death the Academy and Section have lost a faithful and efficient officer, and the members a worthy associate.

Our Conservator, Mr. Geo. W. Tryon, Jr., reports forty-seven donations of shells from twenty-nine different sources, all of which have been labeled and arranged in the museum. "These aggregate 1097 trays and labels, containing 4150 specimens, being a larger accession than for several previous years." Including them, the Conchological collection embraces 41,322 trays and tablets, with 145,791 specimens.

It may be stated as an illustration of the rapid growth of our museum that about one-third of these specimens have been received since the removal of the Academy to its present building in 1876. Among the donations may be particularized as important, the large collections of New Caledonian, French and Eastern European shells, generously given by Messrs. E. Marie, A. Locard, A. Montandon, and S. Clessin; also the fine collection from Mauritius and Madagascar, purchased from Mr. V. Robillard. Several other purchases of good shells were made, partly with the income of the Museum Fund, partly by money received from the sale of our publications. To obtain all purchasable novelties and desiderata would require a fund yielding an income of not less than five hundred dollars per annum; some rare opportunities were declined during the past year for want of means.

Inadequate as our resources are, our progress has been such as to receive recently the commendation of the distinguished editor of the "Journal de Conchyliologie," who writes of the "immense bibliographical and conchological collections of the Academy of Natural Sciences of Philadelphia, scientific treasures to which each year adds considerably, and which constitute working facilities of the first order." The re-arrangement of the museum, in connection with the publication of the monographs of the genera in the "Manual of Conchology," steadily progresses. The *Columbellidæ* and *Conidæ* have been carefully studied and largely re-labeled during the year; the *Pleurotomidæ* are now undergoing revision.

The officers of the Section are:—

Director, ...	W. S. W. Ruschenberger.
Vice-Director, . . .	John Ford.
Secretary, ...	John H. Redfield.
Recorder, ...	S. Raymond Roberts.
Conservator, . . .	Geo. W. Tryon, Jr.
Librarian, ...	Edw. J. Nolan.
Treasurer, ...	Wm. L. Mactier.

On behalf of the Section,

S. Raymond Roberts,

Recorder.

REPORT OF THE ENTOMOLOGICAL SECTION.

During the year past the Entomological Section has held ten meetings, at which the attendance has averaged six members, exclusive of visitors.

During the year one member has resigned, and one died. No new members have been elected, and the Section at present numbers twenty-one members.

The Section has experienced an irreparable loss in the decease of its late Director, Dr. John L. LeConte. His long services in the advancement of entomology in this country are too well known to require any rehearsal here. At the annual meeting of the American Entomological Society, it was ordered that a memorial of Dr. LeConte be prepared, and published in the Society's Transactions.

The Transactions of the American Entomological Society, vol. x, containing 344 pages and 9 plates, has been published. The Proceedings of the Entomological Section continue to be published and issued in connection with the Transactions, and contain the communications made at the monthly meetings. Members and others are thus enabled to place upon record such advanced descriptions as they may desire.

Eleven written communications have been presented for publication, and, having been favorably acted upon, will be duly published.

The Curator reports the following additions to the cabinets:—

From Dr. W. L. Abbott.					
Diurnal Lepidoptera,	237	specimens,	40	species.
Nocturnal Lepidoptera,	11	"	10	"
Odonata,	24	"	10	"
S. F. Aaron.				
Orthoptera,	36	"	22	"
Diptera,	55	"	30	"
Hemiptera,	32	"	20	"
Pseudoneuroptera,	663	"	95	"
Neuroptera,	40	"	12	"
E. M. Aaron.				
Neuroptera,	79	"	20	"
Pseudoneuroptera,	87	"	28	"
Odonata,	9	"	7	"
Diurnal Lepidoptera,	84	"	63	"
G. B. Cresson.				
Diptera,	200	"	75	"
E. T. Cresson.				
Hymenoptera,	11,677	"	number of species not determined.	

Additions were also made at various times by Dr. H. Skinner, who has given no list of the same.

Through the attention bestowed upon it by Mr. E. T. Cresson, the collection of Hymenoptera is in a specially good condition, and is beyond doubt the best in America.

The cabinets have been examined and disinfected, so that they now present a thoroughly good appearance. This is a part of the Conservator's labors in connection with entomological collections that always requires much care and time. Great assistance has been rendered to the Conservator by Mr. S. F. Aaron, who has devoted much care to the specimens. The same gentleman has also helped greatly in the arrangement of the Entomological library.

By resolution passed November 9, the Section expressed its hearty accord with the Curator of the Academy in the formation

of a local museum, and directed the Conservator to render such assistance as laid in his power.

At the meeting held December 10, the following officers were elected for the ensuing year:—

Director,	George H. Horn, M. D.
Vice-Director,	Rev. H. C. McCook, D. D.
Recorder,	James H. Ridings.
Conservator,	Eugene M. Aaron.
Publication Committee,	J. Frank Knight, H. Skinner.

Respectfully submitted,

JAMES H. RIDINGS,

Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section has pleasure in reporting to the Academy that the activity and prosperity of the Section heretofore noted, still continue. The growth of the Herbarium is fully detailed in the report of the Conservator submitted herewith. Meetings have been held regularly every month, except during the summer recess, and much interesting matter communicated and papers presented, some of the more important of which have appeared in the general Proceedings of the Academy. The Section is wholly free of debt, and has a surplus in its treasury, and has at present thirty-two members on the roll.

The officers elected to serve during 1884 are:—

Director,	Dr. W. S. W. Ruschenberger.
Vice-Director,	Thomas Meehan.
Recording Secretary,	F. Lamson Scribner.
Cor. Secretary, *Treasurer*,	Isaac C. Martindale.
Conservator,	John H. Redfield.

Respectfully submitted,

THOMAS MEEHAN,

Vice-Director.

Conservator's Report.—The Conservator reports that during the year 1883, now closing, the donations of plants to the Academy's Herbarium have been 2868 species. It is estimated that over 900

of these are new to the collection, adding 72 genera not before represented. The North American and Mexican species received were 1438; from the West Indies and South America were received 233; and from the Old World 1197. Referring to the appended list of donations for details, we may here call attention to the large and valuable additions contributed by Dr. Gray, of the Cambridge Herbarium, representing the floras of every quarter of the globe; a small collection from Australia, presented by Baron von Müller, through Mr. Meehan—nearly all of its species new to us: a collection of about 70 species of interesting Patagonian plants, made by Mr. William Bell, of the Transit of Venus expedition, and presented by him through Mr. Charles E. Smith; upwards of 400 species of plants from various regions, presented by Mr. Canby; and 51 species of Scandinavian Lichens, mostly new to the collection, presented by Dr. J. H. Eckfeldt.

These have all been poisoned, catalogued, placed in papers and distributed in their proper places in the Herbarium. This necessary work has left little time to devote to the improvement of the condition of the Herbarium generally, yet some progress has been made in that respect. Provisional lists of species have been continued as far as the order Borraginaceæ in the general Herbarium. The Endogens have been re-arranged to conform to the order adopted by Bentham and Hooker in the concluding part of their "Genera Plantarum," that vast monument of careful, patient, analytic work. And some small progress has been made in the much needed task of mounting the specimens of the North American Herbarium.

Heretofore the Academy's collection of plants has received the benefit of a large amount of faithful and intelligent labor from its late Curator-in-charge, Mr. Charles F. Parker, but his disability during the early part of the year, followed by his death on the 7th September, 1883, has deprived us of his services; and now the Conservator realizes, more than ever before, how much we have owed to Mr. Parker's diligent zeal and skilful hands. In his absence we have been indebted to the aid of Messrs. Burk, Meehan, Scribner and Brinton, who have each rendered efficient service. Mr. Scribner, though absent several months on explorations in Montana for the Northern Transcontinental Survey, has continued his critical work upon the grasses of our collection, and has made some progress in the work of mounting them.

It is very desirable that the Herbarium of the Academy should be in such condition as will make it most accessible and useful to botanists who may visit it during the meeting in this city next year of the American Association for the Advancement of Science and of the British Association; and though it will be impossible to do all that should be done in the brief intervening period, it is hoped that much may be accomplished towards this end, and that good progress may be made in the mounting of at least the North American plants.

JOHN H. REDFIELD,
Conservator.

December 10, 1883.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

Meetings of the Section have been held regularly during the year, the attendance averaging from eight to ten. The discussions have been more upon geological questions than upon mineralogical, owing to the interest excited by the Geological Survey of the State. The most important event to the Academy in connection with mineralogy has been the accession of the Vaux collection, and its arrangement by Mr. Jacob Binder, whose services in that matter have been of exceeding value.

The officers of the Section are:—

Director, ...	Theodore D. Rand.
Vice-Director, . . .	W. W. Jefferis, Esq.
Recorder and Secretary, .	Dr. A. E. Foote.
Conservator, ...	Prof. H. Carvill Lewis.
Treasurer, ...	John Ford.

Respectfully submitted,

THEODORE D. RAND,
Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALÆONTOLOGY.

The Professor of Invertebrate Palæontology respectfully begs to report that during the past year he has delivered a course of twenty-six lectures on physiographic geology and palæontology, which course, extending through the months of January, February and March, as in previous years, was attended in principal part by teachers belonging to the various institutions of learning of the city.

He further reports that the collections under his immediate supervision have been materially improved through identifications and re-determinations incident to study, and this more particularly in the special fields of Tertiary and Cretaceous palæontology; in the latter department the institution is largely indebted to Prof. R. P. Whitfield, of New York city, for numerous determinations of the fossils belonging to the State of New Jersey. The additions to the palæontological department of the Academy's museum, which are recorded elsewhere, have been inconsiderable, but it is hoped that local exchanges will shortly be instituted, whereby valuable accessions to an already very extensive collection will be insured.

A course of lectures, beginning with about the middle week of January, and embracing a discussion of the physical history and palæontology of the States of Pennsylvania and New Jersey, has been arranged for the coming year.

Very respectfully,

ANGELO HEILPRIN,

Professor of Invertebrate Palæontology.

REPORT OF THE PROFESSOR OF MINERALOGY.

The Professor of Mineralogy respectfully reports that during the past year a course of lectures, upon the mineralogy, lithology and geology of Philadelphia and vicinity, has been delivered, alternately in the lecture room of the Academy and in the field. The course treated of mineralogy in its relation to lithology and geology, and of geology, both structural and historical, with special reference to the formations in the vicinity of the city. The

field lectures were given at various points, where the strata, with their enclosed minerals or fossils, could be studied in place. Owing to the exceptional geological position of the city, excursions could be made to all the principal geological formations, from the Laurentian to the Quaternary, inclusive. Among the places visited were the mineral localities of Philadelphia, Bucks and Delaware counties, the iron-mines and marble-quarries of Montgomery county, the metalliferous veins and the Triassic rocks of the Perkiomen Creek and elsewhere, the marl-pits of New Jersey, the Palæozoic strata along the Lehigh, and the coal regions of Mauch Chunk. The attendance averaged about forty, about half of whom were ladies. Reports of these lectures, as published in a city newspaper, are herewith deposited in the library of the Academy.

The mineralogical collection has increased steadily, as shown by the annexed list of donations. The magnificent collection of the late William S. Vaux, Esq., referred to in last year's report, and more particularly described in the report of its Curator, has been deposited as a special collection, under certain conditions, in a room fitted up for the purpose, and is a most valuable and noteworthy addition to the collections of the Academy.

A local collection of Pennsylvania minerals is now being formed on the lower floor of the museum, in connection with a systematic display of the natural history of the State, and the aid of collectors is hereby asked to make this collection as complete as possible. The arrangement adopted for it is that of M. Adam, of Paris (as followed by Descloiseaux, Pisani, etc.), since it serves better the purpose of public instruction than the classification of Prof. Dana, according to which the general collection is arranged.

In the hope that the generous friends of the Academy will assist in supplying a much-felt want, attention is again drawn to the urgent need of scientific instruments (goniometer, lithological apparatus, etc.), both for instruction and for original investigation in this department.

Respectfully submitted,

H. Carvill Lewis,

Professor of Mineralogy.

REPORT OF THE CURATOR OF THE WM. S. VAUX COLLECTIONS.

The Curator of the Wm. S. Vaux Collections respectfully reports to the Council of the Academy of Natural Sciences that the systematic arrangement of the collections has been completed. A catalogue has yet to be made and a portion of the labeling finished. The entire collection is now in a condition to be opened for inspection and study.

It may be hereafter found desirable to rearrange some of the specimens, so that those from the same locality be brought into closer proximity; but this can be attended to hereafter.

On the 15th of August the arrangement and classification were commenced. The Council of the Academy having made an appropriation to defray necessary expenses, Mr. G. Howard Parker, to whom acknowledgment is due for valuable services, was engaged as an assistant, and acted in that capacity until the 15th of September.

For the expenses of arrangement, reference is made to the report of the Treasurer of the Academy.

The collection has been arranged in seven upright cases, marked from A to G, and thirty-nine horizontal cases, numbered from 1 to 39. They are made of Honduras mahogany, each having four drawers, securely fastened with Yale locks. They are as nearly dust-proof as possible, and the workmanship is entirely satisfactory.

The archæological part of the collection occupies five of the upright cases, marked from A to E, and five of the horizontal, marked from 1 to 5. The specimens number (counting arrow-heads and small implements by trays as one piece) two thousand four hundred and forty-five (2445), arranged in groups according to locality. They consist of stone axes, hatchets, celts, hammers, pestles, balls, shovels, hoes, arrow-, spear- and lance-heads, discoidal or Chunkee stones, ceremonial implements, copper and bronze axes, mound pottery; Indian, Mexican, Peruvian, Costa Rican, Roman and Carthagenian antiquities.

The localities represented are: Italy, Switzerland, Germany, France, Sweden, Denmark and Ireland, and America, from Maine to Florida and from the Atlantic to the Pacific coast, with Mexico, Peru and Costa Rica; with a few implements of the Esquimaux and the South Sea Islanders. They include specimens of the palæo-

lithic and neolithic periods, of the work of the cave and lake dwellers, the mound builders, ancient Mexicans, Peruvians and Indians of America, and from the kitchen-middens of Denmark.

The mineralogical part of the collection has been arranged and classified under the system of J. D. Dana, 5th edition, 1869. It embraces 5302 specimens, representing 466 species or groups, all mounted in trays and labeled.

All of which is respectfully submitted,

JACOB BINDER,

Curator.

The election of Officers for 1884 was held, with the following results:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	William C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.,
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.,
	Angelo Heilprin.
Councillors to serve three	George Y. Shoemaker,
years, ...	Aubrey H. Smith,
	William L. Mactier,
	George A. Koenig, Ph. D.
Finance Committee, .	Isaac C. Martindale,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	George Y. Shoemaker.

ELECTIONS DURING 1883.

MEMBERS.

January 30.—John B. Deaver, M. D., G. Howard Parker, Clarence R. Claghorn, F. A. Genth, Jr., Jacob Wortman, H. T. Cresson, William L. Springs, Emily G. Hunt.

February 27.—Walter Rogers Furness.

April 24.—Daniel E. Hughes, M. D., Edwin S. Balch.

May 29.—N. Archer Randolph, M. D., J. Reed Conrad, M. D., Spencer Trotter, M. D.

August 28.—Charles Peabody.

September 25.—Henry F. Claghorn, Emanuele Fronani.

October 30.—S Mason McCollin, Francis A. Cunningham.

November 27.—Mrs. William M. Ellicott, George L. Knowles, Ferdinand McCann, Lewis E. Levy, J. Alexander Savage.

CORRESPONDENTS.

May 29.—Arnould Locard, of Lyons; Frederick W. Hutton, of Christchurch, N. Z.; C. E. Beddome, of Hobart Town, Tasmania.

October 30.—Eugene A. Rau, of Bethlehem, Pa.

November 27.—Marchese di Monterosato, of Palermo; E. Marie, of Paris; H. J. Carter, of Burleigh-Salterton, England.

ADDITIONS TO THE MUSEUM.

December 1, 1882, to December 1, 1883.

ARCHÆOLOGY, ANTIQUITIES, IMPLEMENTS, ETC.—H. Skinner. Fragment of terra-cotta head from Mexico.

H. C. Lewis. Palæolithic implements from the glacial gravels at Trenton, N. J., collected by C. C. Abbott.

W. S. Jones. Two Indian carved images from Alaska.

T. D. Rand. Spanish water-jar from Barcelona; 2 Peruvian water-jugs; Catawba Indian pottery (1 piece); fragments of pottery from Lancaster County, Pa

T. R. Peale. Breech-clout, Oahu, Sandwich Islands.

J. M. Willcox. Two Indian implements from Brevard County, Florida.

Specimen of Wedgewood ware, designed by J. Flaxman, of London.

MAMMALIA (recent and fossil.)—J. Leidy. Molar tooth of *Equus major* (?), found near Keenville, N. Y.

J. Swartzle. Jaw fragments of *Platygonus vetus* Leidy, type of species from Mifflin County, Pa.

Mr. Magee. *Felis concolor*, from Colorado.

J. Jeanes. Two skulls, and the greater portion of the skeleton of *Platygonus compressus*, from northern New York.

J. Wortman. *Mus decumanus* (disarticulated skeleton).

J. C. Willson. *Mus musculus* (skeleton).

Zoological Society of Philadelphia. *Capra hircus* (incomplete skeleton); *Vulpes littoralis*; *Felis pardalis* (skull); *Eumatopius Stelleri* (skull).

BIRDS.—T. C. Craig. Cape pigeon (*Daption Capensis*), from Cape Horn, S. A.

A. F. Gentry. Skeleton of parrot (*Chrysotis albifrons*), from Cuba, W. I.

Zoological Society of Philadelphia. Vulturine Guinea fowl (*Numida vulturina*), Africa; *Buteo borealis* (skeleton).

REPTILES AND AMPHIBIANS (recent and fossil).—O. C. Marsh. Cast of Pterodactyl (*Ramphorhynchus phyllurus*), from Eichstädt, Bavaria.

M. Smiley. Tooth of *Crocodilus fastigiatus*, from the Eocene of Virginia.

J. L. Wortman. *Hyla versicolor*, *Tropidonotus leberis*.

H. C. McCook. Horned frog (*Phrynosoma coronata*), from California.

FISHES (recent and fossil).—E. Zeitler. Box fish (*Diodon* sp).

S. Trotter. Skull of *Prionotus*.

A. Wenrich. Fossil fish (*Diplomystus analis*), from Wyoming Territory.

M. S Quay. Tarpum (*Megalops thrissoides*), from Florida.

N. Spang. Pharyngeal bone and teeth of *Mylocyprinus robustus*, from the Post-pliocene of Idaho.

ARTICULATES (Crustaceans, insects, arachnids, and myriapods, recent and fossil).—J. Jeanes. *Cambarus primævus*, from the Eocene of Wyoming Territory; shrimp (*Æger spinipes*); 5 *Libellulæ* and 2 *Hemiptera*, from the lithographic slate of Solenhofen, Bavaria.

J. Harley. *Belostoma grandis*, hemipterous insect.

J. Ford. Crab (*Gelasimus pugilator*), 3 specimens, from Atlantic City, N. J.

T. Meehan. Goose barnacle (*Lepas anatifa*), on sea-weed, from Killinos Island, Alaska.

T. L. Casey. 187 specimens of unidentified Coleoptera, from Wellington and Cape Town, S. Africa.

MOLLUSCA (recent).—John Ford. *Bulimus Patasensis* (Patas, Peru); *Cypræa helvola* (no locality); *Turbinella scolymus* (locality ?); two species of marine shells; *Crepidula glauca* (Cape May, N. J.).

Museum of Comparative Zoology, Cambridge. *Achatinella simularis* (Waimea), Pease collection.
S. Clessin. 20 species of land shells, from Eastern Europe.
A. E. Bush. 17 species of marine and fresh-water shells, from California.
W. D. Hartman. *Helix Mozambicensis* (near Lake Nyassa, Africa); 1 species of land shell.
A. Montandon. 64 species of land and fresh-water shells, from the Carpathian Mountains of Moldavia, and from Bucharest, Wallachia.
A. Locard. 225 species of land and fresh-water shells (1600 specimens), from France.
F. G. Sanborn. 2 species of marine shells, from Martinique.
W. W. Calkins. *Conus testudinarius*, from the West Indies.
C. R. Orcutt. 3 species of marine shells, from California, and Lower California; 10 species of marine shells, from San Diego, Cal.; 4 species of marine shells.
W. Bell. *Trophon liratus*, *T. crispus*, *T. Geversianus*, and *Pecten*, species, from Santa Cruz River, Patagonia.
G. H. Parker. 10 species of marine shells, from near Galveston, Texas; 6 species of marine shells, from near Galveston, Texas; 2 species of marine shells.
Mrs. A. E. Bush. *Helix*, from San Pedro, Cal.; 13 species of marine shells.
F. R. Latchford. 2 species of fresh-water shells, from Ottawa, Can.
F. W. Hutton. 9 species of marine shells, from New Zealand.
A. Garrett. 84 species of land shells, from the Society Islands.
A. A. Hinkley. *Unio camptodon*, Washington Co., Ill.
R. E. C. Stevens. 3 species of marine shells, from the Gulf of California and Japan; 2 species of fresh-water shells.
M. L. Leach. 11 species of land and fresh-water shells.
T. Bland. 6 species of land and marine shells.
T. R. Peale. 1 species of marine shell.
G. W. Tryon, Jr. 8 species of marine shells.
J. Willcox. 6 species of fresh-water shells.
C. Headly. 6 species of land and fresh-water shells.
B. H. Wright. 1 species of fresh-water shell.
L. H. Streng. 1 species of fresh-water shell.
E. Marie. 81 species of marine, land, and fresh-water shells, from New Caledonia; 28 species of land, marine, and fresh-water shells, from New Caledonia; 151 species of land, marine, and fresh-water shells, from New Caledonia, and the Islands Mayotte, Anjouan, and Nossi-Bé.
M. L. Leach. 5 species of land and fresh-water shells, from Michigan.
P. C. Tucker. 4 species of marine shells, from Texas.
B. Sharp. Semperian preparations of *Limax cineroniger* and *Cyclostoma elegans*.
Conchological Section, A. N. S. 2 species of *Triquetra* (Santarem, Brazil); 63 species of land, marine, and fresh-water shells, new to the collection; 33 species of land and fresh-water shells from the islands of Nossi-Bé and Mayotte, collected by E. Marie; 102 species of land, marine, and fresh-water shells; 215 species of land, marine, and fresh-water shells, from Mauritius, collected by M. V. Robillard.

MOLLUSCA (fossil.)—W. Bell. *Ostrea Patagonica*, *Turritella Patagonica*, *Cardita Patagonica*, *Tellinoides oblonga*, *Venus meridionalis*, *Dosinia* sp., *Lucina* sp.—Probably Eocene of Patagonia (Santa Cruz River).
J. Leidy. *Orthoceras* sp. From the Carboniferous of Fayetteville, Arkansas.
J. D. Conley. *Nucula Randalli*, from the Hamilton group of Madison Co., N. Y.
J. T. Rothrock. Miocene Coquina (with *Pecten Madisonius*, *P. Jeffersonius*, *Crepidula*, *Balanus*, etc.), from Jamestown Island, James River, Va., and from the James River, S. of Point of Shoals Lighthouse.
P. C. Tucker. Two species of probably Post-pliocene shells, from Galveston Bay, Texas.

WORMS, ECHINODERMS, CŒLENTERATES AND SPONGES (recent and fossil).—C. R. Orcutt. 8 species of Serpulæ.

J. Jeanes. 4 sponges, from Florida.

J. Leidy. *Spongilla lacustris*, from the Schuylkill River, Philadelphia.

E. Potts. *Spongilla lacustroides*, from W. Branch of Chester Creek, Del. Co., Pa.

J. L. Curry. *Leptogorgia virgulata* (locality ?).

J. T. Rothrock. *Columnaria sexradiata*, from the Miocene of James River, Va.

C. Morris. *Tubularia indivisa*, from Atlantic City, N. J.

BOTANY (recent).—Wm. M. Canby. 403 species plants from Europe, Syria, Madeira, South Africa, North Africa and Australia; 30 species collected by himself in Montana, in August, 1882, of which 9 were new to the Herbarium; flowers of *Rhododendron Vaseyi*, from plant brought from Jackson Co., N. C.; roots and stem of *Dryas Drummondii* Hk., from sand-bars of Blackfoot R., Montana.

Dr. Asa Gray, Cambridge Herbarium. 435 species collected by Cosson and others in Europe, Western Asia and N. Africa (*Reliquiæ Mailleanæ*); 77 species from the Province of Minas Geraes, Brazil; 24 species of Cyperaceæ, collected by Dr. Schweinfurth in tropical Africa; 40 species from China, Feejee Islands, Ecuador, etc. (from Kew Herbarium); 234 species of plants collected by Havard, Palmer, Schaffner and others, in the northern provinces of Mexico and in western Texas; 29 species of *Rosa*, from Herb. of J. G. Baker, European or cultivated at Kew Garden; 48 species of Arctic plants, collected in Lapland, etc., by C Flahault and others, in 1878 and 1879; 102 species plants from Morocco and Algeria; 60 species Cuban plants, mostly collected by Rugel in 1849.

Dr. Sereno Watson, of Cambridge. 69 species collected by him in 1880 in Montana, Idaho and Washington Territories.

Baron F. von Müller, of Melbourne, Australia. 52 species of rare Australian plants.

F. L. Scribner, of Philadelphia. *Diplachne viscida* Scribn. (new). *Sporobolus depauperatus*, Arizona, and *Festuca rubra* L., var. *grandiflora* Hæckel, Sweden.

Geo. W. Holstein, of Belvidere, N. J. 35 species plants from Mitchell Co., Texas.

Thomas Meehan. 7 species *Cactaceæ*, mostly from the western regions of the U. S.; specimens of *Forsythia suspensa* Wahl., and *F. viridissima* Lindl., from seeds of same parent, showing them to be forms of one species; *Hesperalöe yuccæfolia*, cult. at Augusta, Ga.; *Bletia aphylla* Nutt, Austin, Texas; *Protococcus nivalis* (Red Snow), collected on summits of Sierra Nevada, California, by Dr. Harkness, of San Francisco; *Lewisia rediviva* Pursh, Nevada; *Protomyces viticola*, Ellis, n. sp. of fungus on roots of grapevine, Chestnut Hill.

John H. Redfield. 255 species plants collected in Western States and Territories by Pringle, Parish Bros, Brandegee, etc.; 551 species plants collected in northern provinces of Mexico and on the Texan border, by Parry and Palmer.

Wm. Bell, through Charles E. Smith. 80 species plants from Santa Cruz R., Patagonia, collected on Transit of Venus Expedition.

Wm. H. Dougherty. Fruit of *Vanilla planifolia*, Mexico.

J. Donnell Smith, of Baltimore. 21 species ferns collected in Jamaica, by J. Hart, mostly new to the Herbarium.

Aubrey H. Smith. Three species of Californian plants new to the Herbarium, collected by John Eaton Leconte.

Thos. Bland, of N. Y. Capsule and seeds of 5 species West Indian plants.

Isaac Burk. 22 species of introduced plants, mostly from ballast ground, Phila., and *Helianthus giganteus* L., var., from Cape May.

Chas. Miller. *Rumex Berlandieri*, Arizona; fruit of wild Vanilla, Mexico.

Dr. W. S. W. Ruschenberger. Wood of the Tomalo, from Samoa.

Isaac C. Martindale. Ellis's 10th Century of N. American Fungi; *Dalea Ordiæ* Gray, a new species from Arizona; part of the trunk of a white birch branching into two limbs, afterwards reuniting into one.

Amer. Phil. Society. Specimens of *Selaginella lepidophylla*, from Mexico.

Prof. Jos. P. Lesley. Grains of wheat and barley, found germinating in a block of ice

J. A. McNiel, of Binghampton, N. Y. Capsule of Sand-box tree (*Hura crepitans*), from Panama, S. A.

Dr. John W. Eckfeldt. 51 species of Scandinavian Lichens, named—most of them new to the Academy's collection.

Thos. Meehan and John H. Redfield. 148 species plants collected in Arizona by H. H. Rusby, in 1883.

Prof. H. Carvill Lewis. Radical leaves of *Argyroxiphium Sandvicense*, etc., from Sandwich Islands.

J. G. Lemmon, Oakland, California. *Tagetes Lemmoni* Gr., a new species from Arizona.

Col. Robert W. Furnas, Brownville, Neb. Wood of *Maclura aurantiaca*, taken from far below the surface of the ground, supposed to have been buried 200 years, and estimated from its annual rings to be from a tree 300 years old. Also, wood of *Salix cordata*, var. *vestita*.

Botany (fossil).—J. Jeanes. *Populus latior*, var. *rotundata*, *P. latior*, var. *cordifolia*, *Acer trilobatum*, *Cinnamomum Scheuchzeri*, *Salix tenera*, *Podogonium Lyellianum*, *P. Knorii*, and *Carpolithus pruniformis*, from the Molasse of Oeningen.

W. Bell. Silicified wood, from the Eocene (?) of Patagonia (Los Missiones).

Minerals.—Joseph Leidy. Axinite, Bethlehem, Pa.; Argentiferous Wavellite, Leadville, Col.; Limonite, pseudomorph after Gryphea, Mullica Hill, N. J.; Lepidolite, Auburn, Me.; Quartz with Pyrophyllite, Hot Springs, Ark.; Cookeite with Rubellite and Quartz, Mt. Mica, Me.; Muscovite, Chester Co., Pa.; Muscovite with Biotite crystals, Macon Co., N. C.; Tourmaline in Muscovite, Mt. Mica, Me.; Green-black Tourmaline in Muscovite, Mt. Mica, Me.; Serpentine with crystals of Chrysotile, Easton, Pa.; Green Tourmaline with nodule of Achroite, Paris, Me.; Rose Tourmaline, Mt. Mica, Me.; Rubellite, Mt. Mica, Me.; Heliotrope, India; Green Tourmaline with Lepidolite, Auburn, Me.; Rhodophyllite, Texas, Pa.; Kaolinite, Summit Hill, Pa.; Muscovite, showing 30 rays, Canada; Muscovite with hexagonal markings, Georgia; Homogeneous anthracite, and anthracite presenting a fused appearance, found in association with quartz crystals, in cavities of the calciferous Sandstone, Herkimer Co., N. Y.; Rubellite, and Rubellite passing into Indicolite, Mt. Mica, Me.; Green Tourmaline passing into fibrous Rubellite, Hebron, Me.; Allophane, Polk Co., Tenn.

W. H. Jones. Garnets, from Stikine River, Alaska.

Theodore D. Rand. Quartzite with (organic?) markings, Radnor, Pa.; Asbestos and Serpentine, Radnor Station, Pa.; Chrysotile, Radnor Station, Pa.

H. T. Cresson. Feldspar crystal, Leiperville, Pa.

C. S. Bement. Cinnabar, New Almaden, Cal.; Cinnabar and Metacinnabarite, Lake Co., Cal.; Pyrites, I. Elba and Freiberg, Saxony; Hematite, Elba and Mt. Vesuvius; Bournonite, Przibram, Bohemia; Spinel, Orange Co., N. Y.; Quartz, pseudomorph after Barite, Roxbury, Conn.; Green Pyroxene, St. Lawrence Co., N. Y.; Beryl, Quartz, Albite, and Orthoclase, Elba; Garnets in gneissose granite, Avondale, Pa.; Orthoclase, St. Lawrence Co., N. Y.; Orthoclase with Quartz, Ural Mts.; Orthoclase with Quartz, Lomnitz, Silesia; Tourmaline, McComb Co., N. Y.; Sphene, St. Lawrence Co., N. Y.; Wavellite, Hot Springs, Ark.; Apatite, Renfrew, Ontario; Plagionite, Wolfsberg, Harz Mts.; Crocidolite, Griqua Terr., S. Africa; Cancrinite, Litchfield, Conn.; Barite, Felsöbánya, Hungary; Anglesite, Sardinia; Strontianite, Hamm, Westphalia.

A. E. Foote. Heulandite on Zoisite, Chabazite with Leidyite, Chabazite, from Leiper's Quarry, Del. Co., Pa.

H. Skinner. Native Tellurium, Boulder Co., Col.; Massive Menaccanite, Fairmount Park, Phila.; Water-worn rock simulating Indian implement, Athens, Pa.; Native Tellurium, Boulder Co., Col.; Columbite, Greenland.

Joseph Jeanes. Pyrite (twin crystal), with Hematite, from Elba; Hematite crystals, Caoradi, Tavetsch Thal, Switzerland; Stibnite, Japan; Celestine, from Egypt, Girgenti, and Put-in-Bay, Lake Erie.

H. Burgin. Argentiferous Arsenopyrite, Continental Divide, Col.; Schirmerite, Summit Co., Col.; Pyrargyrite, Argentiferous Tetrahedrite, Kelso Mt., Col.; Fluorite, iridescent Quartz, White Beryl, Garnet in Albite, Microlite in Albite, Allanite in Albite, Microcline, Muscovite, Pink Muscovite in Albite, Albite, Orthoclase, Kaolinite, Columbite in Albite, and Monazite in Albite, all from Amelia Co, Va.; Vanadiferous Wulfenite, Phœnixville, Pa.; Ankerite, Chester Co., Pa.

M. E. Newbold. Amber, from the greensand of Vincentown, N. J.

W. H. H. Bates. Hornblende, from South Windsor, Me.

S. R. Calhoun. Chalcedony geode, containing water, from the Rio Salto, Uruguay.

J. M. Hartman. Octahedral crystal of Cuprite, France.

W. P. Miller. Wulfenite, from Arizona.

J. Binder. Chalcopyrite, Mt. Desert I., Me.

C. R. Gaul. Mesolite and Calcite, from Fritz's Island, near Reading, Pa,

F. V. Hayden. Viandite, Yellowstone National Park.

Purchased. Corundum, Iredell Co., N. C.; Variolite, Tyrol; Variolite pebble, Durance, France; Margerite and Emery, Chester, Mass.

In Exchange. Phosphorescent Limestone, Utah.

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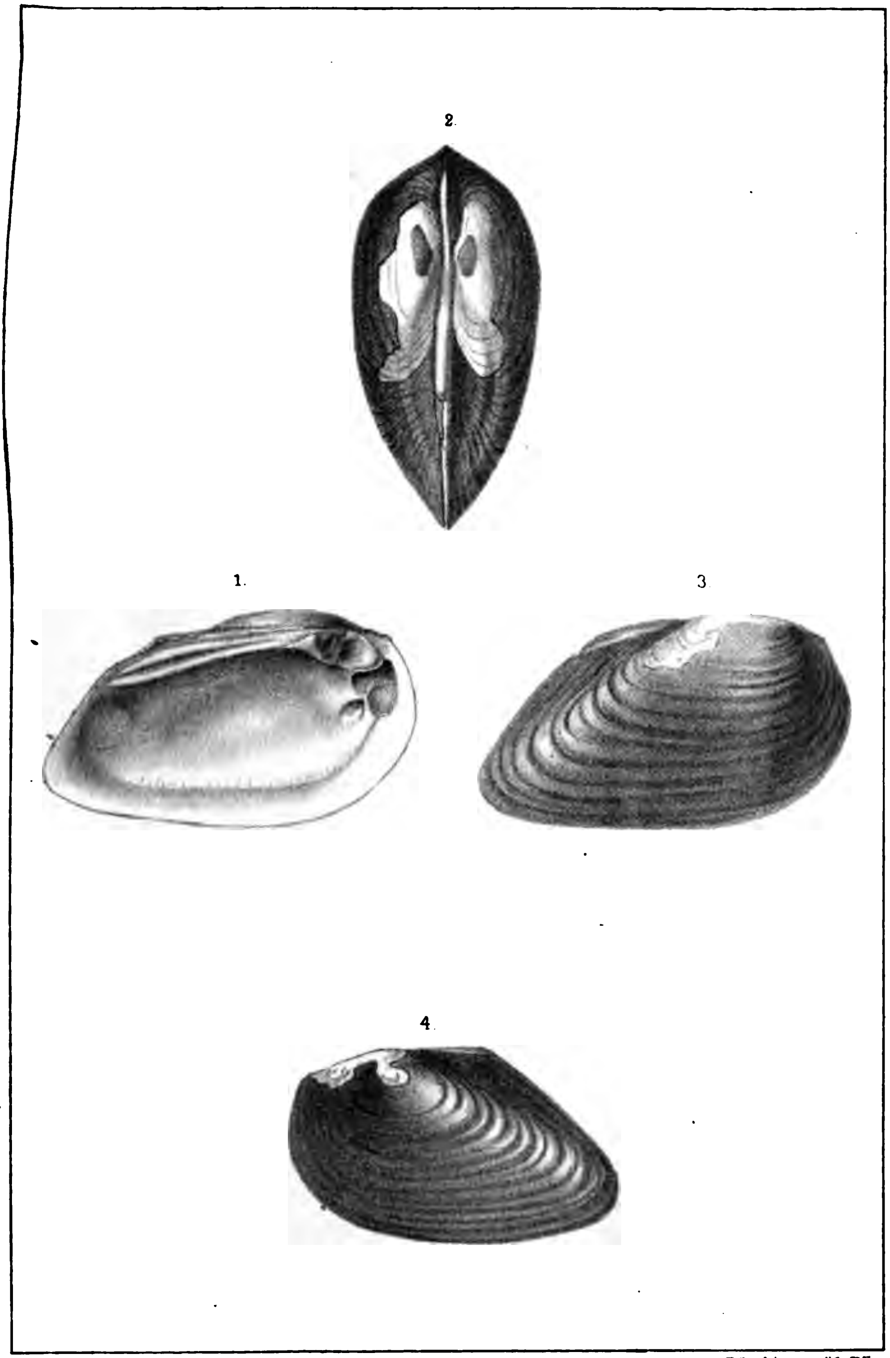

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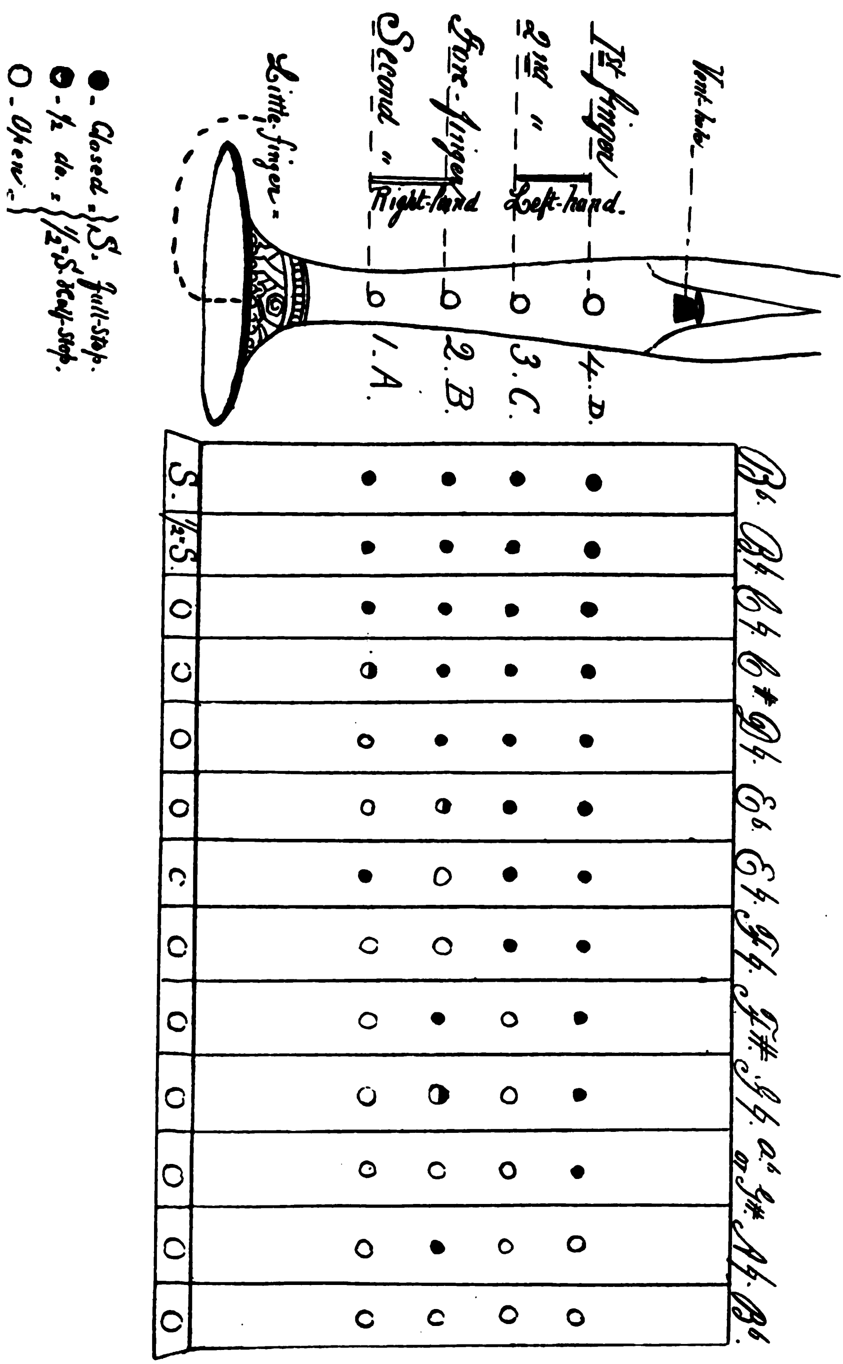

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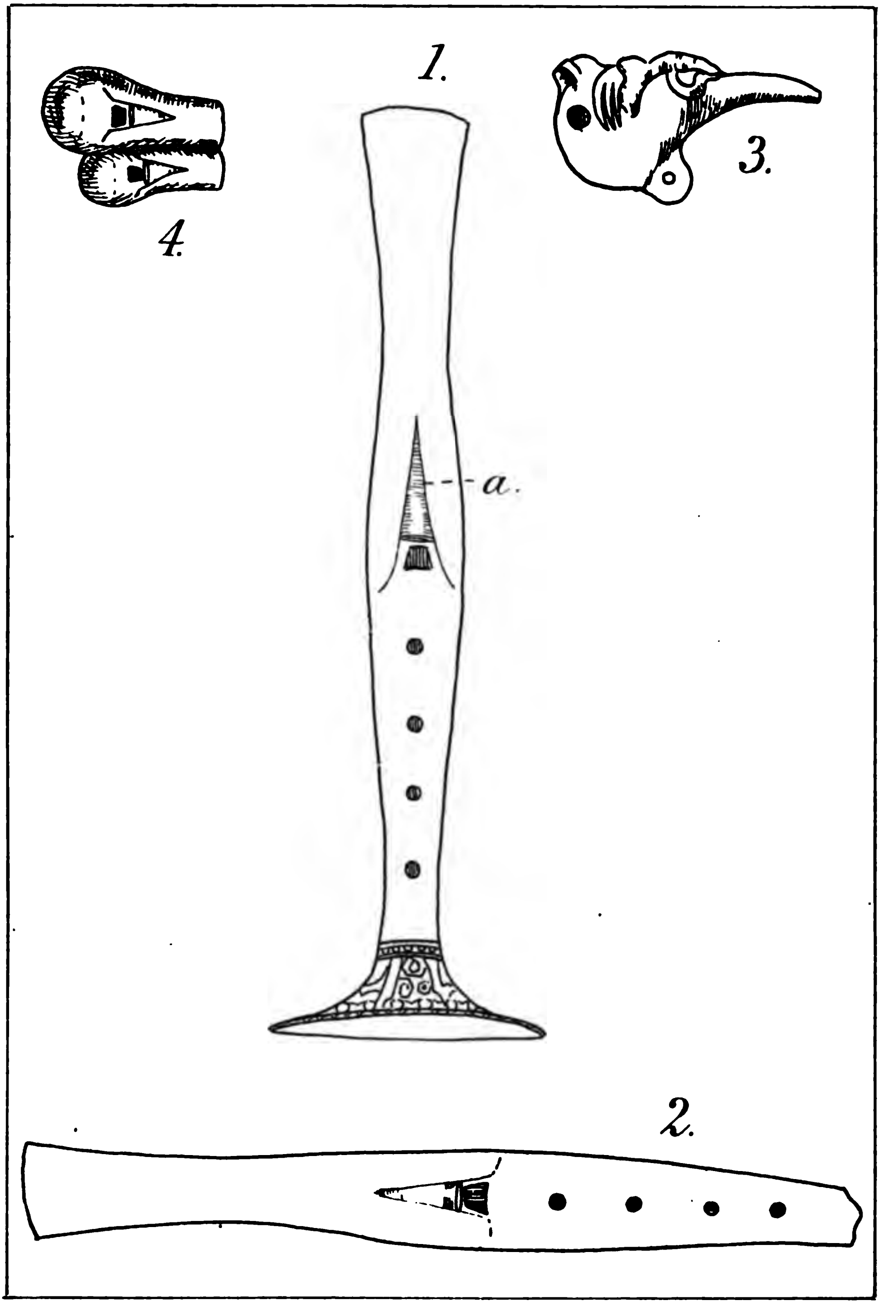

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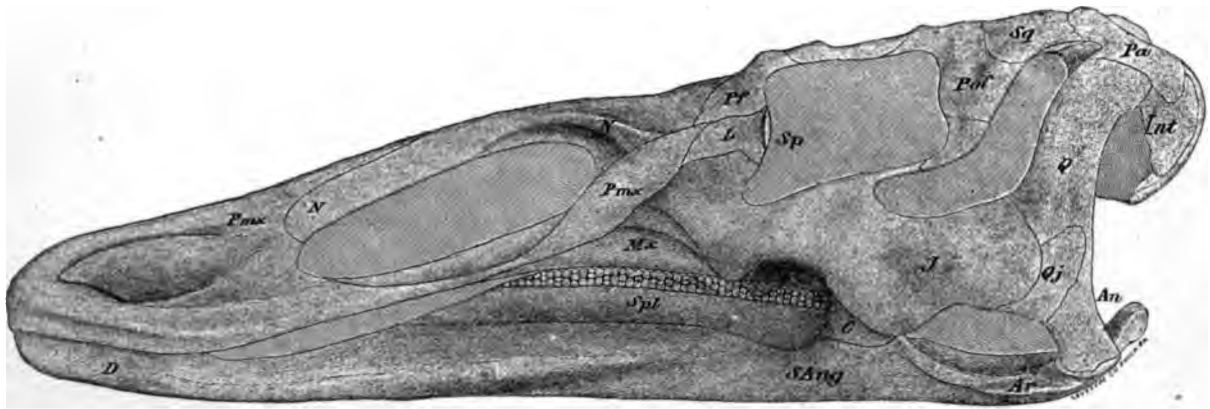
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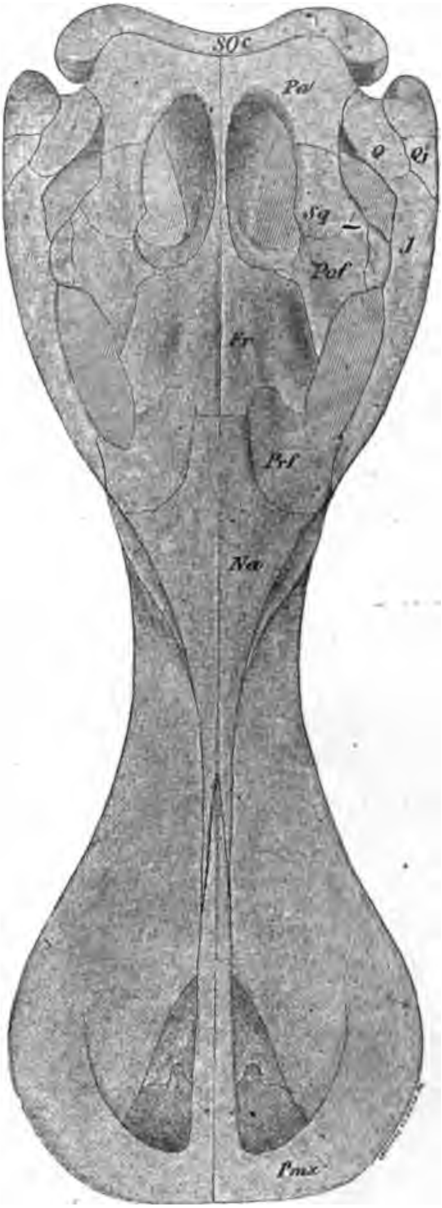

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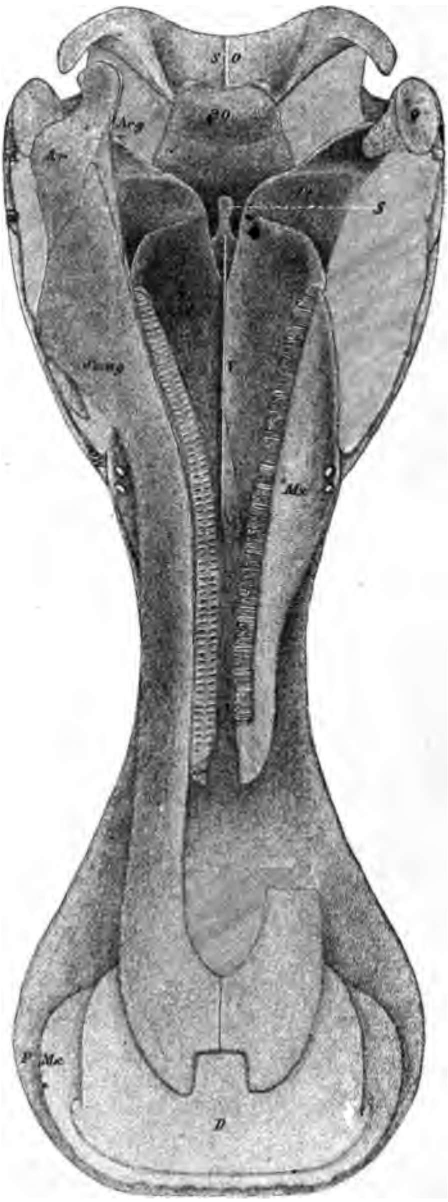

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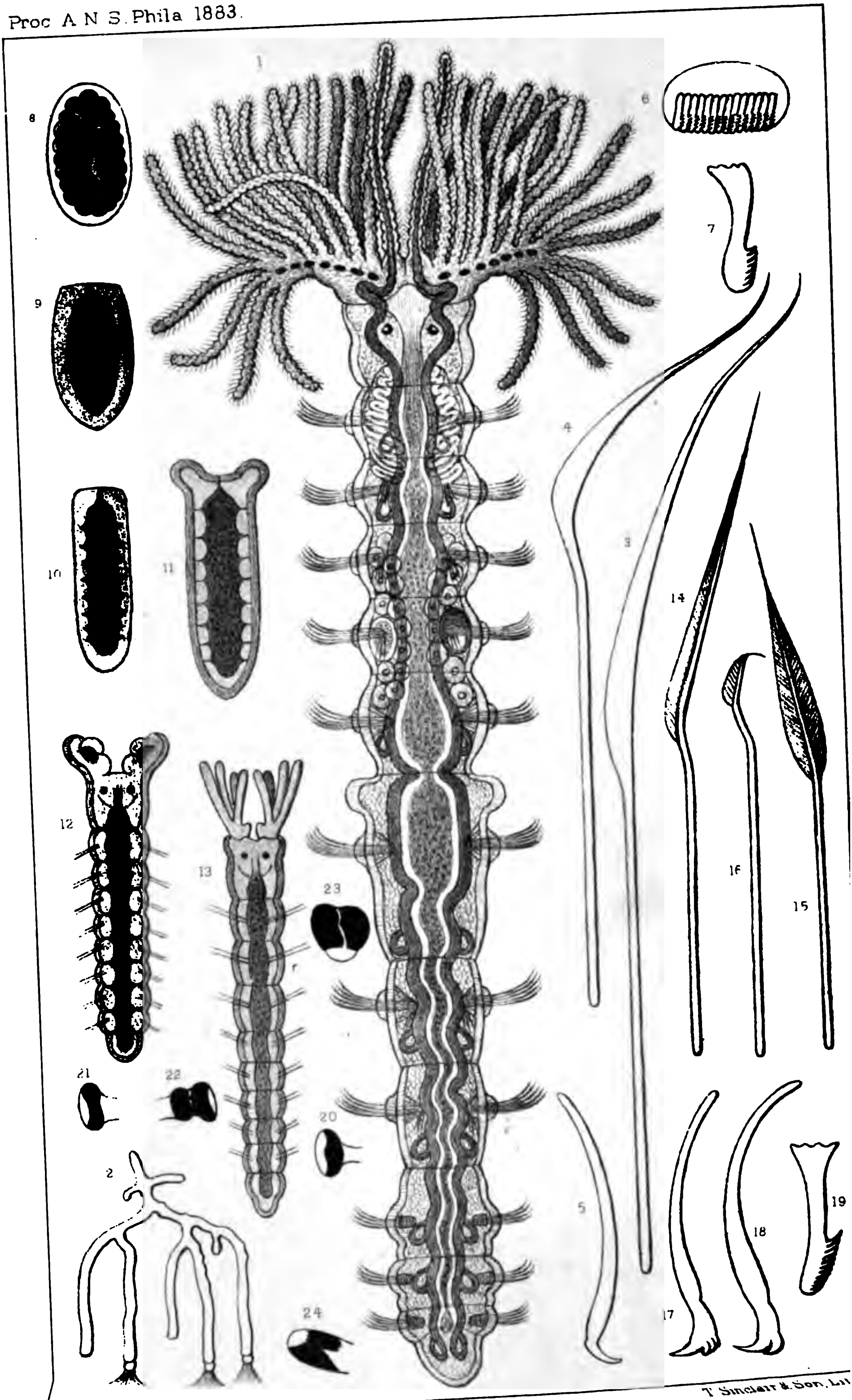

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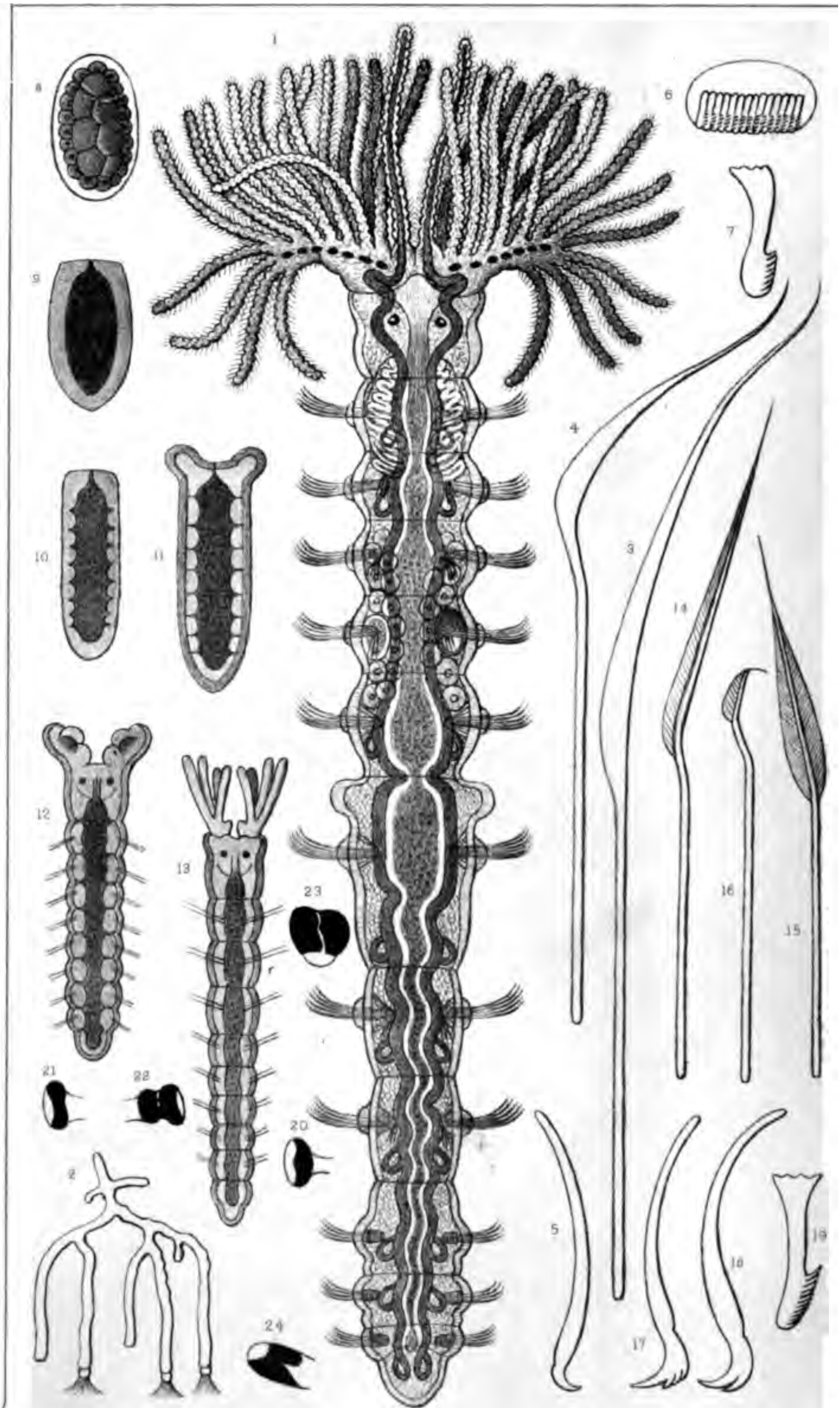

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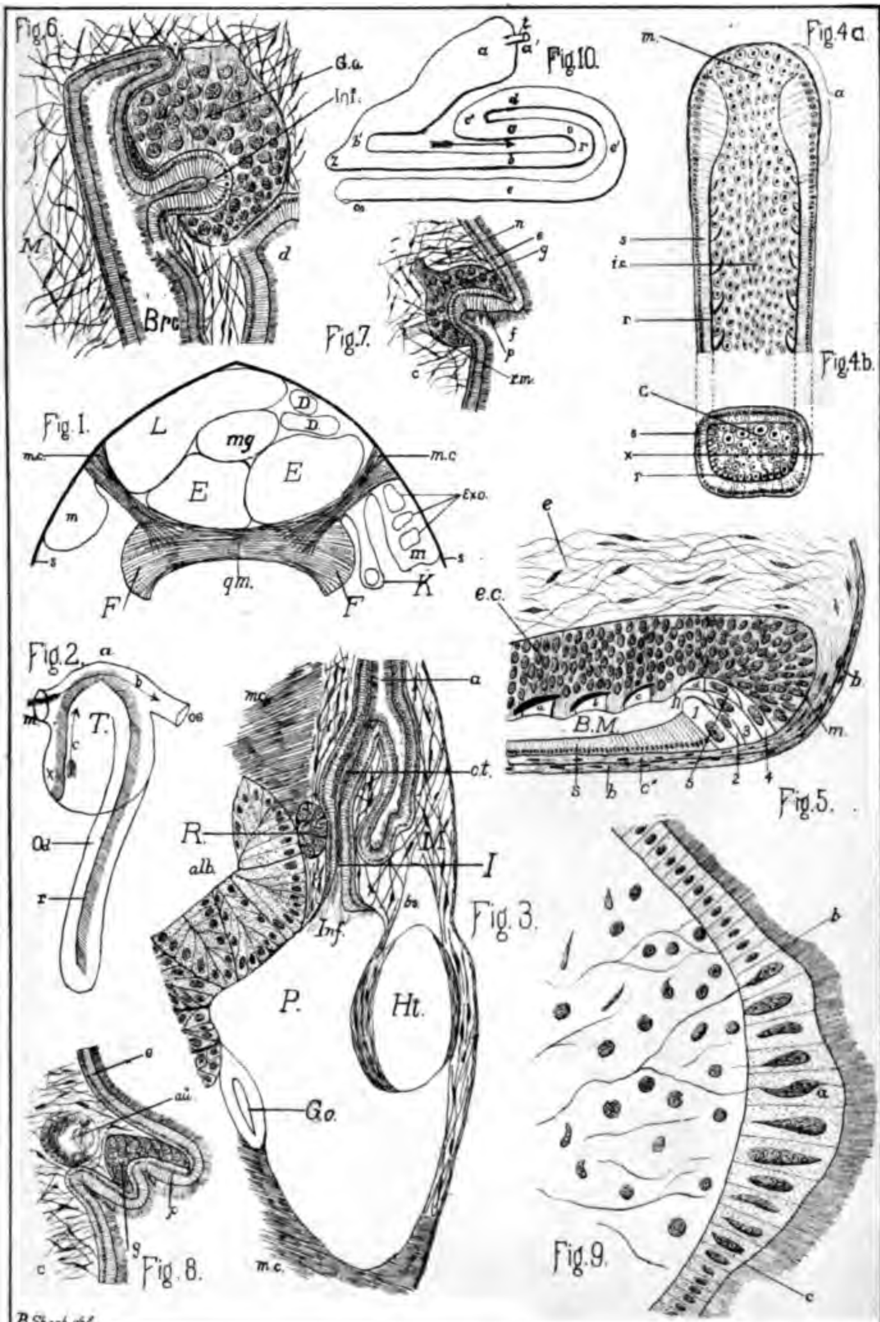

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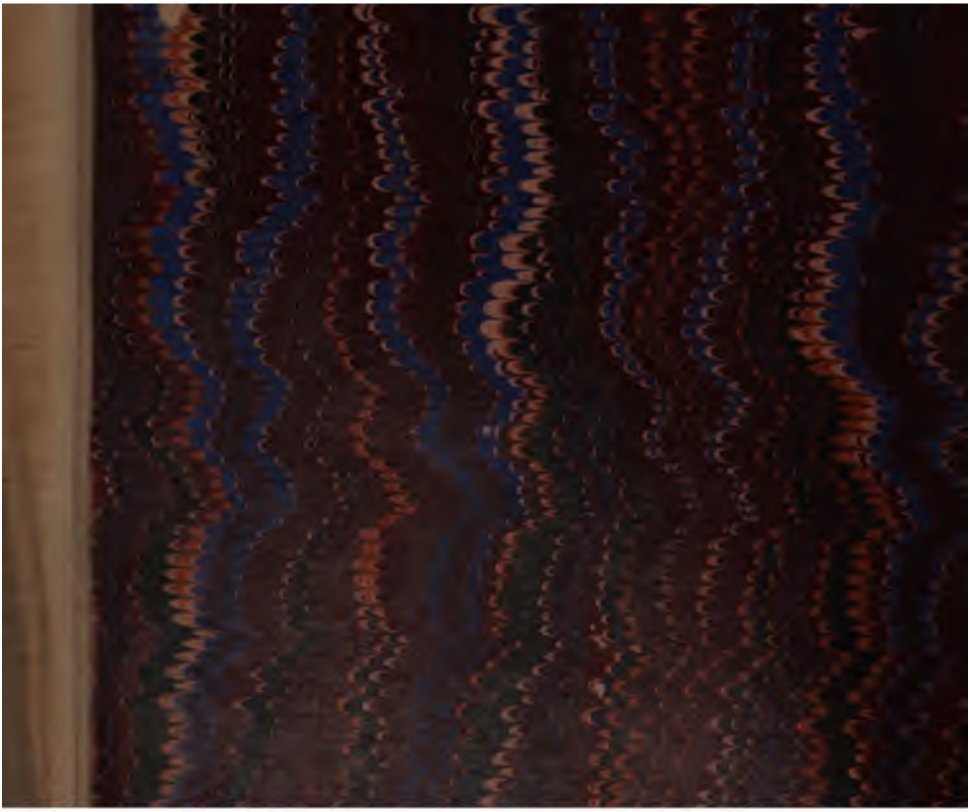

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